Reconstruction of British Columbia Sockeye Salmon *(Oncorhynchus nerka)* Stocks: 1970-1982

P. J. Starr, A. T. Charles, and M. A. Henderson

Department of Fisheries and Oceans
Fisheries Research Branch
1090 West Pender Street
Vancouver, British Columbia V6E 2P1

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Department of Fisheries and Oceans
Fisheries Research Branch
1090 West Pender Street
Vancouver, British Columbia V6E 2P1

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ABSTRACT

Starr, P. J., A. T. Charles, and M. A. Henderson. 1984. Reconstruction of British Columbia sockeye salmon (Oncorhynchus nerka) stocks: 1970-1982. Can. MS Rep. Fish. Aquat. Sci. 1780: 123 p.

A coastwide assessment of all British Columbia sockeye (Oncorhynchus nerka) stocks for the period 1970-1982 is made in this report. Data inputs used include escapement (number and timing) by stock, catch by area, and known migratory routes for each stock. Separation of catch into component stocks is made proportionate to the escapement of each stock following a procedure known as run reconstruction. In general, all major B.C. sockeye stocks show no discrenable trend or are increasing in the period covered by the report. Some minor stocks, particularly in the Queen Charlotte Islands, the Central Coast and Johnstone Strait, appear to be decreasing. Limitations in the quality of the data, particularly in escapement counts, make the assesssment of stocks in remote areas uncertain.

Key words: salmon, assessment, reconstruction

RÉSUMÉ

Starr, P. J., A. T. Charles, and M. A. Henderson. 1984. Reconstruction of British Columbia sockeye salmon (Oncorhynchus nerka) stocks: 1970-1982. Can. MS Rep. Fish. Aquat. Sci. 1780: 123 p.

Le présent rapport contient une évaluation, couvrant la période 1970-1982, de tous les stocks de saumon rouge (Onchorhynchus nerka) peuplant les côtes de la Colombie-Britannique. Les données utilisées comprennent les échappées (fréquence et distribution temporelle) selon le stock, les prises selon la zone et les voies migratoires connues de chaque stock. Le classement des prises en fonction des stocks individuels est proportionné aux échappées de chaque stock à l'aide de la procédure de reconstitution de la remonte. En général, les principaux stocks de saumon rouge de la C.-B. n'accusent aucune tendance perceptible ou connaissent une hausse pendant la période visée. Certains stocks secondaires, surtout ceux des îles Reine-Charlotte, de la côte centrale et du détroit de Johnstone, semblent décroître. La qualité limitée des données, notamment celles sur la fréquence des remontées, rend incertain l'évaluation des stocks dans les zones reculées.

Mots-clés: saumon, évaluation, reconstitution

Foreword

This report is one in a series of stock assessment documents produced by the Salmon Stock Assessment Unit of Fisheries Research Branch, Department of Fisheries and Oceans (Pacific Region). The report has been made possible through the cooperation and assistance of many people, both within and outside the Department of Fisheries and Oceans.

Ray Hilborn, of the Institute of Resource Ecology at the University of British Columbia, is a co-developer (with Paul Starr) of the run reconstruction methodology utilized in this report.

Ron Kadowski (Fisheries Research Branch; formerly North Coast management biologist, Field Services Branch) played a major role both in the analysis of North Coast and Queen Charlotte Islands sockeye stocks, and the writing of the corresponding sections herein. Lynda Orman (Queen Charlotte Islands management biologist, Field Services Branch), Lyle Enderud (Fishery Officer, Area 1), and the Queen Charlotte Islands district office provided much of the information required for analysing Queen Charlotte Islands stocks. Barry Huber, Barry Rosenburger, and Tim Panko (Fishery officers for Areas 3, 4, and 5 respectively) generously provided their time and expertise, as well as their data, for the North Coast analysis. Dave Peacock, assisted by Ron Goruk (management biologist, Field Services Branch) contributed extensively to the compilation of data required for the reconstruction of Central Coast sockeye stocks. In addition both provided valuable background information required for interpreting the results of the analyses. Steve Heizer (management biologist, Field Service Branch) and Kim Hyatt (Fisheries Research Branch) provided data on sockeye stocks from the west coast of Vancouver Island and assisted in interpreting the reconstruction results. Jim Manzer (Fisheries Research Branch) provided detailed information on the run timing of the Henderson Lake sockeye stock. Analyses of south coast sockeye stocks were aided by Al Gould (management biologist, Field Services Branch), Dr. Jim Woodey (International Pacific Salmon Fisheries Comm.), and Jim Ames (Washington Dept. of Fisheries). Albert Wong (Fisheries Research Branch) wrote summarizing programs, gathered and entered data, and generally kept the project together.

Introduction

Sockeye salmon (Oncorhynchus nerka) have formed an important component of the annual British Columbia salmon catch since the inception of commercial fisheries in the area in the mid-1800's (Foerster, 1968). Prior to 1916 most of the salmon catch consisted of sockeye although in subsequent years they were replaced in numerical dominance by pink (Oncorhynchus gorbuscha) and chum salmon (Oncorhynchus keta). Nevertheless, sockeye salmon continued to form a major part of the annual salmon harvest. For example, between 1970 and 1982 an average of 25% of the annual salmon catch (in pieces) consisted of sockeye. The importance of the sockeye catch is particularly evident in years with a dominant Adam's River run (ie. ... 1970, 1974, 1978, 1982). In these years upwards of one out of every three salmon caught off the coast of British Columbia is a sockeye.

Relative to the other species of Pacific salmon, sockeye stocks are few and they are generally restricted to large river systems. The Fraser, Skeena and Nass Rivers and Rivers Inlet are particularly important salmon production systems. Together the total run size of sockeye from these four systems accounts for approximately 87% of the total British Columbia sockeye run size. In part it is this concentration of sockeye salmon stocks into a few major river systems that has made them the target of intense commercial exploitation.

During the initial years of commercial harvesting sockeye salmon were caught almost exclusively with gillnets in terminal escapement areas. In more recent times however both seiners and trollers have competed with gillnetting operations for the same fish. During the period 1953 to 1962, approximately two thirds of the total sockeye catch was taken by gillnet and one third by seine net. Trollers accounted for less than one percent of the total catch. Since that time the distribution of sockeye catch by gear has changed considerably. Between 1973 and 1982 the annual gillnet catch of sockeye decreased to approximately 50% of the total catch while the seine and troll catch increased to 40 and 10% respectively. The change in allocation of catch among gear types has created several management problems, one of the most serious being the increased difficulty in estimating harvest rates by stock. Trollers, and to a lesser extent seiners, often operate far from terminal escapement areas and consequently may catch sockeye from several different stocks. Without detailed information on run timing and routing through various fisheries it is very difficult to generate reliable harvest rate estimates on a stock-by-stock basis.

The objective of this report is to generate the information required to assess the status of sockeye salmon stocks in British Columbia. Specifically we estimate the catch, escapement, total run size and harvest rate between 1970 and 1982 for all major commercially exploited stocks. In addition, we provide information on the run timing of sockeye stocks entering the fisheries. While there are many instances where individual sockeye stocks have come under scrutiny in the past, this is the first attempt at a systematic, coast-wide analysis of sockeye salmon stocks. The information contained herein is essential both for evaluating the effects of past management actions and for providing a reliable basis on which to develop new management initiatives.

The report is divided into several sections. First is a description of the method of analysis, data sources and an annotated example of the results of the analysis for one stock. This is followed by a coastwide perspective for British Columbia sockeye salmon in the years 1970 to 1982. Following are stock-by-stock descriptions of the same, grouped into five broad, management defined geographical areas (Fig. 1): Queen Charlotte Islands (statistical areas 1 and 2), North Coast (statistical areas 3, 4 and 5), Central Coast (statistical areas 6 through 10), West Coast of Vancouver Island (statistical areas 21 through 27) and South Coast (statistical areas 11 through 20, 28 and 29).

Methodology

The Run Reconstruction Approach

The results presented in this report have been obtained using a method of analysis known as run reconstruction. The method addresses a basis problem in salmon stock assessment: if escapement is measured for each fish stock, while catch is determined by fishery, how can the catch in each fishery be allocated between fish stocks to determine total run size? This question must be resolved before a full analysis of harvest rates, exploitation rates, stock and recruitment, and trends in stock sizes can be undertaken.

To allocate catch between fish stocks, one can either follow a static procedure based on historical proportions of the catch in each fishery arising from each stock, or adopt a systematic dynamic method for analysing the movements of each fish stock through and between the fisheries. The former approach is widely known as the 'PRUNES' method, after the allocation table of the same name ("Pacific Region US-Canada Negotiating System"). It is a static methodology, incorporating potentially out-of-date information on fishing patterns, migration rates and timing, and does not take into account year-to-year variations in relative stock strength. The second approach, which is used in run reconstruction, involves estimates of escapement timing (proportions of the fish stock escaping past the last fishery in each time period), migration routings (the possible ways in which each fish stock passes through the various fisheries), and 'diversion rates' (proportions of each stock following each migration routing). Together, this information makes it possible to track each fish stock through the fisheries on a week-to-week basis. Of course, data on timing, routing and diversion rates is by no means complete and precise, but the experience of fishery officers and biologists, together with results from tagging studies, produces the best current estimates, which can be updated each year as new information becomes available.

The run reconstruction approach works backwards in time. Annual escapement data by stock, together with escapement timing information, produce week-to-week escapement values. Using the assumed diversion rates, each stock is subdivided into 'sub-stocks', each sub-stock corresponding to a stock-migration route combination. (For example, the Meziadin sockeye stock of Area 3 is assumed to follow one of 3 migration routes into its escapement area; there are thus 3 sub-stocks corresponding to this one major stock. Differences in escapement timing can also necessitate differentiating between sub-stocks of a single major stock). Given the week-to-week escapement for each sub-stock, it is essentially

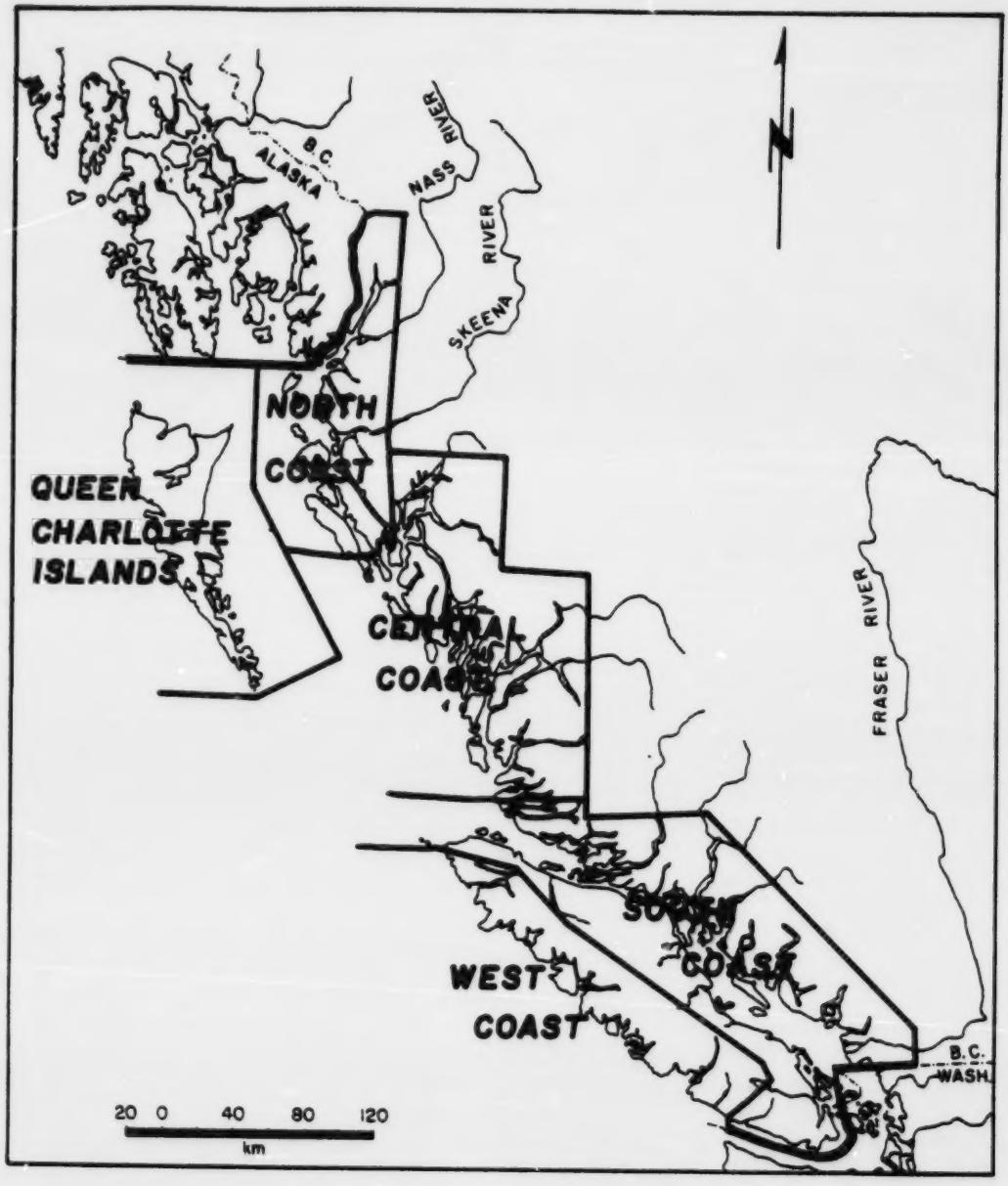


Fig. 1. The five regions of British Columbia used in reconstruction analyses.

a book-keeping exercise to track each sub-stock backwards in time. For each time period, the catch in each fishery is allocated proportionately between all sub-stocks present on the basis of how many fish of each sub-stock are known to have escaped the fishery at the end of the given time period. As the process works back in time, the run of each stock builds up, as more and more catch is added in. Eventually, each sub-stock is tracked back to the time at which it first entered the outer-most fishery along its migration route. At this point, the total entering run has been determined for that sub-stock.

Once catches have been allocated and runs determined, overall harvest rates on each major stock can be calculated, together with the week-by-week timing curve for the entering run of each stock. All this information, when assembled, produces a picture of the stock-by-stock and fishery-by-fishery exploitation pattern for the year under consideration.

While the run reconstruction methodology is straightforward in principle, the key to a successful analysis lies in the choice of appropriate fish stock aggregations, fishery aggregations, and migration route possibilities, as well as the choice of a suitable time step for the analysis. These choices are discussed in Hilborn & Starr (1984), where details of the run reconstruction process are also presented. Here we restrict ourselves to pointing out the questions that must be addressed, and how they are dealt with in this report.

Formulating the Run Reconstruction Analysis

As pointed out above, the British Columbia coast has been divided into 5 major areas for this analysis: Queen Charlotte Islands (Areas 1-2), North Coast (3-5), Central Coast (6-10), Fraser River and South Coast inside waters (11-20, 28, 29) and West Coast of Vancouver Island (21-27). In fact, for the reconstruction, the Queen Charlotte Islands and the North Coast were considered as one overall geographical region, in order to ensure that this reconstruction region was more or less self-contained (although some corrections were necessary, as discussed below).

Within each reconstruction region, the relevant stock and fishery aggregations must be determined. Several factors influence the choice of relevant fish stocks:

(1) Does the proposed stock differ in escapement timing and/or migration routing from other stocks?
(2) If not, are there logical reasons for separating the stock from others (such as a different history of exploitation or a special significance)?
(3) In any case, does the proposed set of stocks make sense, with respect to the biological and management concerns?

The stocks used in this report are more aggregated than one might feel appropriate from a biological point of view. However they represent a balance between biological correctness, data availability, computer limitations, and manageability of the fish stocks. The rationale for the choice of stocks is presented, for each geographical region, in the corresponding section below.

The choice of fisheries is intertwined with the selection of a suitable time step for the analysis. If fish move rapidly from the outermost fishery to

escapement, then either fisheries must be aggregated into larger units, or a finer time step must be used. The primary requirement is that a given fish must be resident in only one fishery within a given time step. For example, if a time step of one week is used for the North Coast/Queen Charlotte Islands region, then the fisheries of Areas 3, 4 and 5 must be aggregated, since fish move between these areas in less than one week. Alternatively, a shorter time step could be adopted, but this has its limitations since data on catch, escapement timing and travel times are known only imprecisely. For this report a compromise time step of 1/2 week was used in the analysis (but results are presented cn a weekly basis for ease of understanding). Using the 1/2 week time period, appropriate fishery aggregations were selected and reasonable estimates of travel times between these fisheries were made.

Once the appropriate fishery combinations have been selected, annual catch data can be examined. The basic sources for this data are: Department of Fisheries and Oceans (DFO) annual B.C. Catch Statistics, DFO Pacific Region Historical Salmon Commercial Catch Data System, and the International Pacific Salmon Fisheries Commission (IPSFC). In cases where less aggregated catch data is required, the catch of a statistical area is divided among fisheries in proportion to hail figures obtained by fishery officers during the fishery. Data available on a weekly basis has been divided into 1/2 week time periods according to the following general rules:

(1) troll catch in a given week is divided evenly between the 2 halves of the week.
(2) net catch is allocated entirely to the first half of the week, unless information on the fishery in question shows that openings occurred entirely or partially in the second half of the week.

Note that for Fraser River and Convention Waters catch, daily catch data is readily available and has been used here. In general, however, extensive uncertainties in other components of the analysis (timing, routing and diversion rates) are such that great precision in allocating catch between time periods is not warranted.

Escapement data for each stock aggregation were collated from a variety of sources, including stream catalogues, Field Services Branch and Salmon Commission escapement files, and various reports. For purposes of the analysis, native food fishery catch, where significant, has been added into escapement data. (This catch information, available by statistical area, is allocated to major stocks within a statistical area in proportion to the escapement.) However, final results presented below include native food catch under 'Catch' rather than 'Escapement'. Escapement timing information was obtained with widely varying degrees of confidence: sources included test fishery data, 'catch per unit effort' data, stream catalogues, and to a large extent, management biologist and fishery officer estimates. Typically the latter information involved estimates of the start, peak and end of the escapement past the last commercial fishery; a symmetric binomial timing distribution was then fit to these 3 dates, and adjustments made for any unusual features of the timing. Where possible, the timing data were obtained for each stock within a stock aggregation, and the overall timing calculated as an average, weighted by the mean relative run size for each stock.

Formulation of migration routing possibilities for each stock is the most difficult aspect of the run reconstruction procedure. While catch and escapement counts and timing estimates are based on physical measurements or observations, migration routes and the proportion of the stock following each route must be inferred from the appearance of fish in the fisheries (unless extensive tagging studies have been carried out in the area). In some cases, such as the West Coast of Vancouver Island, routings may be very simple. In other cases, for example the North Coast and Central Coast areas, many possible routes exist from the outermost fisheries to escapement, and the 'diversion rate' proportions are unclear. However past tagging studies, in particular the Central Coast Salmon Tagging Report (Aquatic Resources Ltd., 1980) and the 1982 North Coast Salmon Tagging Report (Gazey and Birdsall, 1983), have been used to provide some guidance in selecting major routing possibilities and reasonable diversion rates for these regions. In the South Coast and Fraser River area, the North approach and South approach (north and south of Vancouver Island respectively) are the key migration routes; the diversion rates for these 2 approaches have been studied for many years but are still very unpredictable from one year to the next.

Run Reconstruction Results: An Example

As described above, the run reconstruction process occurs on a year-by-year basis. Each run reconstruction produces an analysis of all stocks within the major geographical region under consideration. The 6 outputs produced are as follows:

(1) Summary Table of total annual run, catch, escapement and harvest rate by stock and sub-stock,
(2) The distribution of catch of each stock between fisheries,
(3) The proportional allocation of the catch in each fishery to the stocks vulnerable to that fishery,
(4) The entering run timing for each sub-stock (ie. the proportion of the sub-stock entering the outermost fishery in each time period),
(5) The harvest rate in each fishery during each time period,
(6) The weekly catch contributions from each stock in each fishery (eg. the catch of each stock, and sub-stock, in a particular fishery for a given week).

Since the emphasis in this report is on the status of the fish stocks, rather than on the state of the fisheries, the results presented here are organized by fish stock. Outputs (1) and (2) above have been amalgamated into one table, while the entering run timing results for each stock have been averaged over the time frame of this analysis (1970-1982) to produce a composite timing curve, together with an indication of the variability in the timing. Whereas the run reconstruction process produces a single year's results for all stocks, these results have been rearranged in this report to display 1970-1982 data for each stock separately. In this section, we present annotated samples of the results described in this report.

The summary data table shown below depicts time series of total annual run, catch, escapement and harvest rate, along with the year-by-year proportions of the catch of the stock which are harvested in each fishery. Note that only fisheries impacting on the stock in question are represented in the table. In

the first figure below, the run, catch and escapement results are plotted against time, for the period 1970-1982. For each stock, the scale is chosen appropriate to the overall size of that stock. (Hence one must be careful to note differences in the scales when comparing between stocks.)

The second figure deals with entering run timing. The timing curve represents an unweighted average of the 13 annual timing curves produced for the given stock (where in a particular year entering timing curves for individual sub-stocks have been averaged, weighted by their respective run sizes for that year). Also shown is the median for this averaged curve (ie. the time at which 50% of the total run has entered the system) and a range for this median (the minimum and maximum median times over the period 1970-1982). Taken together, this information provides a reasonable indication of average timing, and variability in that timing, for each stock. Note that there are 4 possible configurations for the median of the average timing curve and the spread in timing. These possibilities are: (i) the spread can be on both sides of the 'average', the spread can be entirely to times (ii) earlier than the average or (iii) later than the average, or (iv) there may be no spread at all (under the assumptions of the analysis).

STOCK : AREA 3 MEZIADIN

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH AREA 1	%CATCH AREA 3XY	%CATCH AREA 3Z	%CATCH NOYES	%CATCH C.FOX
1970	133841	56763	77078	42.41	10.65	3.34	15.40	65.45	0.37	4.79
1971	304618	112944	191674	37.08	5.59	4.65	12.99	59.26	0.01	17.49
1972	240108	110583	129525	46.06	5.59	3.01	16.46	62.53	1.61	10.81
1973	671391	436764	234627	65.05	2.15	0.34	3.77	86.60	1.19	5.94
1974	385348	220089	165259	57.11	5.59	0.63	14.11	76.44	0.09	3.15
1975	94280	40185	54095	42.62	9.53	1.15	7.76	76.04	0.26	5.26
1976	242997	140567	102430	57.85	15.04	0.22	1.99	68.69	0.37	13.71
1977	550871	308520	242351	56.01	6.86	0.15	7.05	77.33	0.74	7.87
1978	240165	129147	111018	53.77	9.07	0.12	9.52	73.16	1.03	7.09
1979	286807	86807	200000	30.27	17.46	1.50	33.98	18.75	15.13	13.17
1980	241767	99767	142000	41.26	18.32	3.41	26.96	17.33	20.91	13.09
1981	370442	156249	214193	42.18	9.75	1.86	23.30	54.39	3.01	7.69
1982	574698	324698	250000	56.50	8.16	0.37	17.09	68.71	2.14	3.54

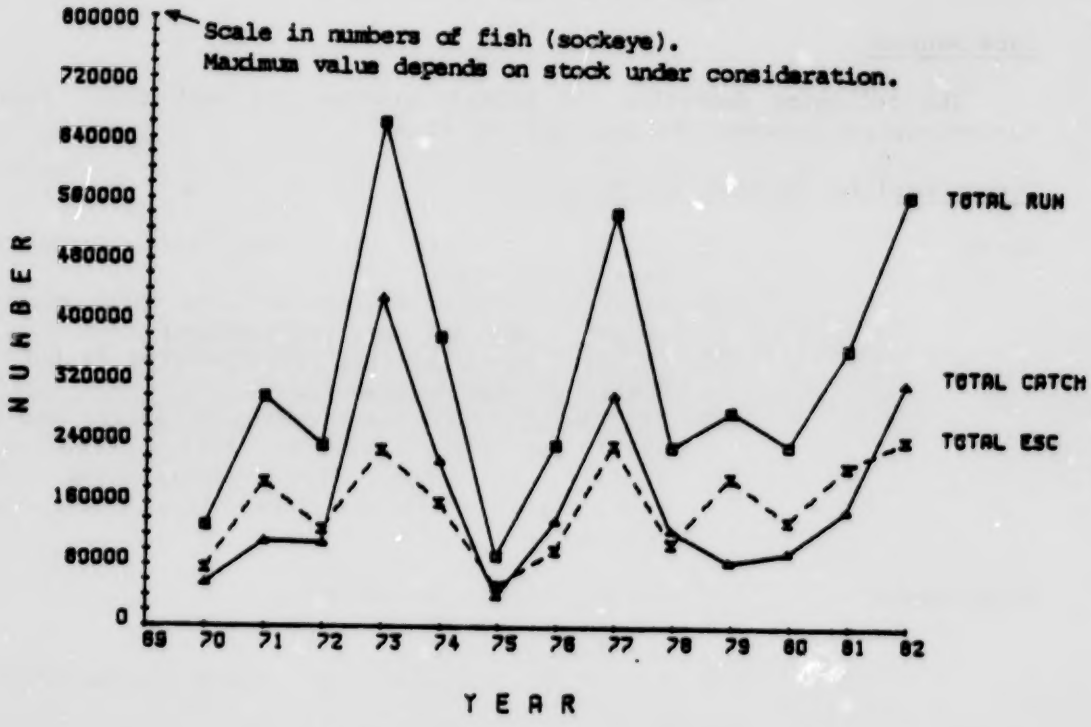
Harvest Rate

$= \frac{\text{Total Catch}}{\text{Total Run}}$

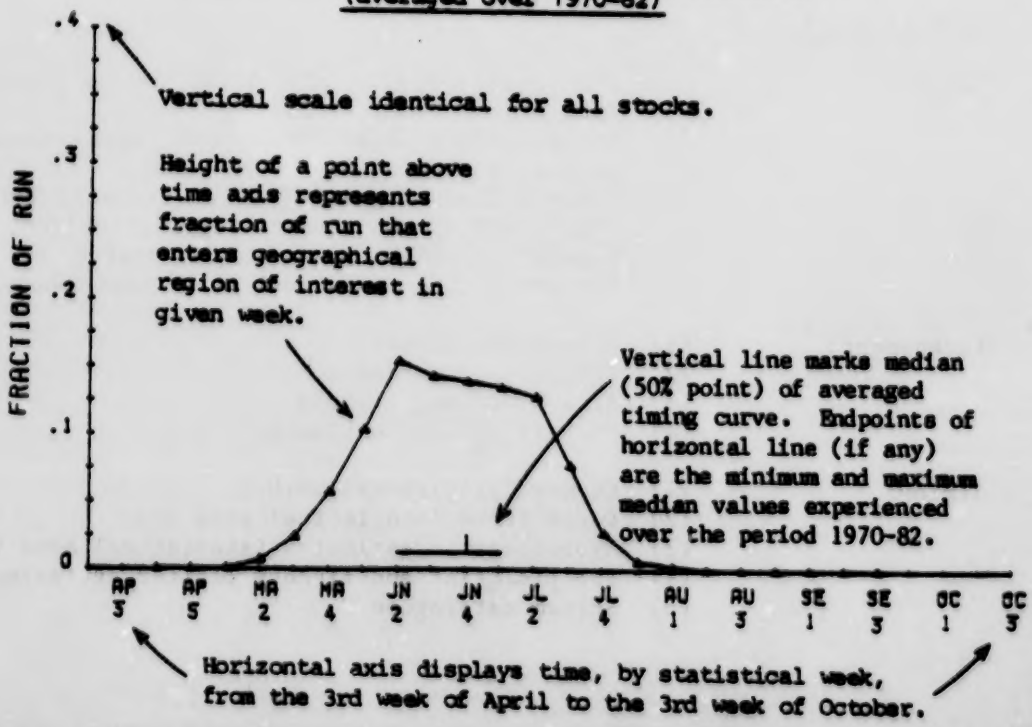
Percentage of total catch obtained in native food fishery (where relevant)

Fisheries of relevance to the given stock: native, Canadian commercial and U.S. fisheries are listed

Year-by-Year Run, Catch & Escapement



Timing curve for "entering run" of given stock
(averaged over 1970-82)


.4
.3
.2
.1
0
FRACTION OF RUN
Vertical scale identical for all stocks.
Height of a point above time axis represents fraction of run that enters geographical region of interest in given week.
Vertical line marks median (50% point) of averaged timing curve. Endpoints of horizontal line (if any) are the minimum and maximum median values experienced over the period 1970-82.
AP 3
AP 5
MA 2
MA 4
JN 2
JN 4
JL 2
JL 4
AU 1
AU 3
SE 1
SE 3
OC 1
OC 3
Horizontal axis displays time, by statistical week, from the 3rd week of April to the 3rd week of October.

Data Sources

The following describes the primary sources for each input into the run reconstruction process, by geographical area.

Queen Charlotte Islands and North Coast

Catch:
(1) DFO Pacific Region Historical Salmon Commercial Catch Data System (Wong, 1982).
(2) Alaska Department of Fish and Game catch statistics (Noyes Island and Cape Fox catches)
(3) Annual 'Area Histories' (Native food fishery catches, Number of days open/week).
(4) 1982 North Coast Tagging Project (Gazey and Birdsall, 1983) and Field Services Branch (FSB) Management Biology estimates (for apportioning catch of interception fisheries into 'local' and 'non-local' components).

Escapement:
(1) Fishery officer estimates
(2) Stream catalogues
(3) FSB revised data
(4) B.C. Fish and Wildlife Department Skeena River analyses

Timing:
(1) Test fishery data
(2) Stream catalogues
(3) FSB biologist and fishery officer estimates
(4) B.C. Fish and Wildlife Department Skeena analyses

Migration Pattern:
(1) 1982 North Coast Tagging Project
(2) FSB biologist and fishery officer estimates

Central Coast

Catch:
(1) DFO Pacific Region Historical Salmon Commercial Catch Data System (Wong 1982)
(2) Annual "Area Histories" and Area Summaries (hail counts, number of days open/week)
(3) Central Coast Tagging Project (Aquatic Resources Ltd., 1980) and North Coast Tagging Project (Gazey and Birdsall, 1983) (apportioning catch of interception fisheries into individual stock components)

Escapement:
(1) Stream catalogues
(2) FSB revised estimate
(3) Area 8 Workshop (1983)
(4) Fishery officer estimates

Timing:
(1) Commercial fishery C.P.U.E.
(2) Docee Fence (statistical area 10)
(3) Hydroacoustic estimates (statistical area 9)
(4) FSB biologist and fishery officer estimates
(5) Stream catalogues

Migration Pattern:	(1)	Central Coast Tagging Study (1980)
	(2)	FSB biologist and fishery officer estimates

West Coast

Catch:	(1)	DFO Pacific Region Historical Salmon Commercial Catch Data System (Wong 1982)
	(2)	Annual "Area Histories" (hail counts, number of days open/week)
Escapement:	(1)	Stream catalogues
	(2)	FSB revised estimates
	(3)	Lake Enrichment Program estimates
	(4)	Fishery officer estimates
Timing:	(1)	Lake Enrichment Programs enumeration of escapement timing of Great Central and Sprout Lake Stocks
	(2)	Stream catalogues
	(3)	J. Manzer, DFO Research Branch, for Henderson Lake Stock
Migration Pattern:	(1)	FSB biologists

South Coast

Catch:	(1)	DFO Pacific Region Historical Commercial Catch Data System (Wong, 1982) (for Canadian catches outside Convention waters)
	(2)	Washington Department of Fisheries Progress Report #180 (1983) (for U.S. catches outside convention waters, including tribal catch, fresh water catch and escapement removals)
	(3)	International Pacific Salmon Fisheries Commission: Daily catches by major fishing area (unpublished) (for catches in Convention waters)
	(4)	DFO South Coast Division Nanaimo office (for Native food fish catches-Canadian non-Fraser)
	(5)	IPSFC Annual Reports and IPSFC racial summaries (unpublished) (for Fraser River native food fish catches)
Escapement:	(1)	DFO South Coast Division Nanaimo Office (for non-Fraser Canadian escapements)
	(2)	IPSFC Annual Reports (for Fraser River escapements)
	(3)	Washington Dept. of Fisheries Progress Report #180 (for U.S. escapements)

Timing:
(1) DFO South Coast Division Nanaimo office test fishing data, peak spawning times and FSB staff estimates, and Anderson (1974) (for non-Fraser Canadian stocks)

(2) IPSFC test fishery data (unpublished) and IPSFC staff (for Fraser stocks)

(3) Wash. Dept. of Fisheries Progress Report #180 and W.D.F. staff (for U.S. stocks)

Migration Patterns:
(1) DFO South Coast Division Nanaimo office, FSB staff, and Anderson (1974) (for non-Fraser Canadian stocks)

(2) Gilhousen (1960), Killick (1955), Henry (1961), and IPSFC staff (for Fraser stocks)

(3) Wash. Dept. of Fisheries staff (for U.S. stocks)

Coastwide Perspective

Annual run size, catch and escapement for all British Columbia sockeye stocks combined varied by approximately a factor of three between the years 1970 and 1982 (Fig. 2). The largest run size and escapement occurred in 1982 at 20.7 and 7.0 million pieces respectively. The largest catch, 13.7 million pieces, was taken in the same year and represents the largest British Columbia sockeye catch since 1958. The lowest run size and catches occurred in the years 1972, 1975 and 1980 at approximately 7.5 and 4.0 million pieces respectively. Escapements were lowest in the years 1972, 1976 and 1980 at approximately 2.6 million pieces. It should be noted that the estimates of catch derived from the reconstruction analyses do not correspond exactly to those published in the annual British Columbia Catch Statistics report. The differences result from the deletion in the British Columbia catch of sockeye of United States origin and the addition to the British Columbia catch of British Columbia sockeye caught in United States fisheries.

Coastwide abundance of British Columbia sockeye salmon is strongly influenced by the four year cycle in abundance of sockeye stocks from the Fraser River system. Abundance maxima for Fraser stocks, occurring most recently in 1982, are generally followed by three years of lower abundance. Of those three years, the year preceding a maximum is the strongest and the weakest occurs two years after the maximum.

There was no consistent trend observed in the combined run size of all British Columbia sockeye stocks between the years 1970 and 1982 (Fig. 2). However, this observation must be viewed with some caution as the combined results do not necessarily reflect the dynamic nature of run size at the individual stock level. Clearly, as will be shown below, the run size of some stocks has declined since 1970. Other stocks have shown an increase in run size, particularly those which have been the focus of enhancement activities such as lake enrichment and the construction of spawning channels.

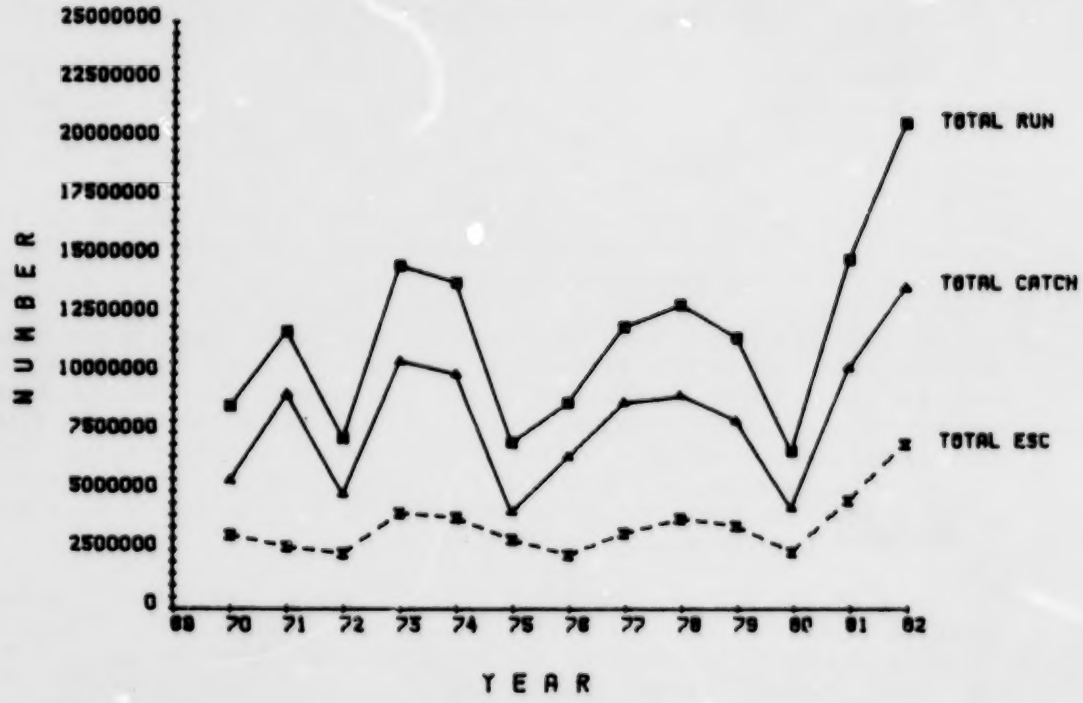


Fig. 2. Catch, escapement and total run size for British Columbia sockeye salmon stocks, 1970 to 1982.

Queen Charlotte Islands

The Queen Charlotte Islands, made up of Graham Island on the north and Moresby Island to the south, are located between 80 and 150 kilometres off the north coast of British Columbia, separated from the mainland by Hecate Strait (Fig. 3). Prince of Wales Island in Alaska is due north of Graham Island across Dixon Entrance. The north, west and east sides of the islands make up DFO Statistical Areas 1, 2 and 2E respectively; these form the boundaries for the three Queen Charlotte Islands sockeye stock aggregations assumed in this report (Table 1).

Sockeye production on the Queen Charlotte Islands is not large compared to that found in other areas on the B.C. coast, but is very important locally since most runs are early in timing and provide the first salmon of the season to the Native food fishery in Areas 1 and 2E.

Commercial sockeye fisheries on the Queen Charlotte Islands are all designed to target on passing stocks, primarily those bound for the Nass, Skeena and Fraser Rivers. Tagging data and scale pattern analysis of the commercial catch generally indicate that this goal is in fact being accomplished. Local stocks are fairly well protected, especially with recent delays in the start of the fisheries at Langara Island in Area 1 and Rennell Sound in Area 2W. See Table 2 for a description of the Areas 1, 2W and 2E sockeye fisheries.

In reconstructing Queen Charlotte Islands/North Coast salmon runs, it is recognized that only a fraction of the catch in each fishery represents the harvest of local (Areas 1-5) fish. To account for this, a table of month-by-month fishery-by-fishery interception rates on 'local' fish has been formulated, blending together results from the 1982 Tagging Project, past tagging studies, and informed judgements. This set of interception rates is shown in Table 3. Note that in Area 2W, the non-local component of the harvest is primarily Fraser River fish.

Each of the 3 Queen Charlotte Islands' stock aggregations is assumed to split between 2 possible migration approach routes. The Area 1 stock group is believed to approach the terminal area from the north, passing the Noyes Island fishery and/or the Area 1 fishery area at Langara Island. The Area 2W stock group migrates into the terminal area either (i) directly or (ii) via Noyes Island and Langara Island. Finally, the Area 2E stock group approaches either via Area 2W or Area 1. The diversion rates for each possible route, together with the terminal timing of each stock, is presented in Table 4. Timing and migration route information used in this report have not been confirmed by scientific study and represent the best estimates of local fishery officers and management biologists.

The overall Queen Charlotte Islands annual run, catch and escapement for the period 1970-1982 are shown in Fig. 4. These results, obtained by aggregating the Area 1, 2W and 2E results described below, indicate a general decline in the total run and the escapement, although 1980 data lie above the 1970-82 average levels.

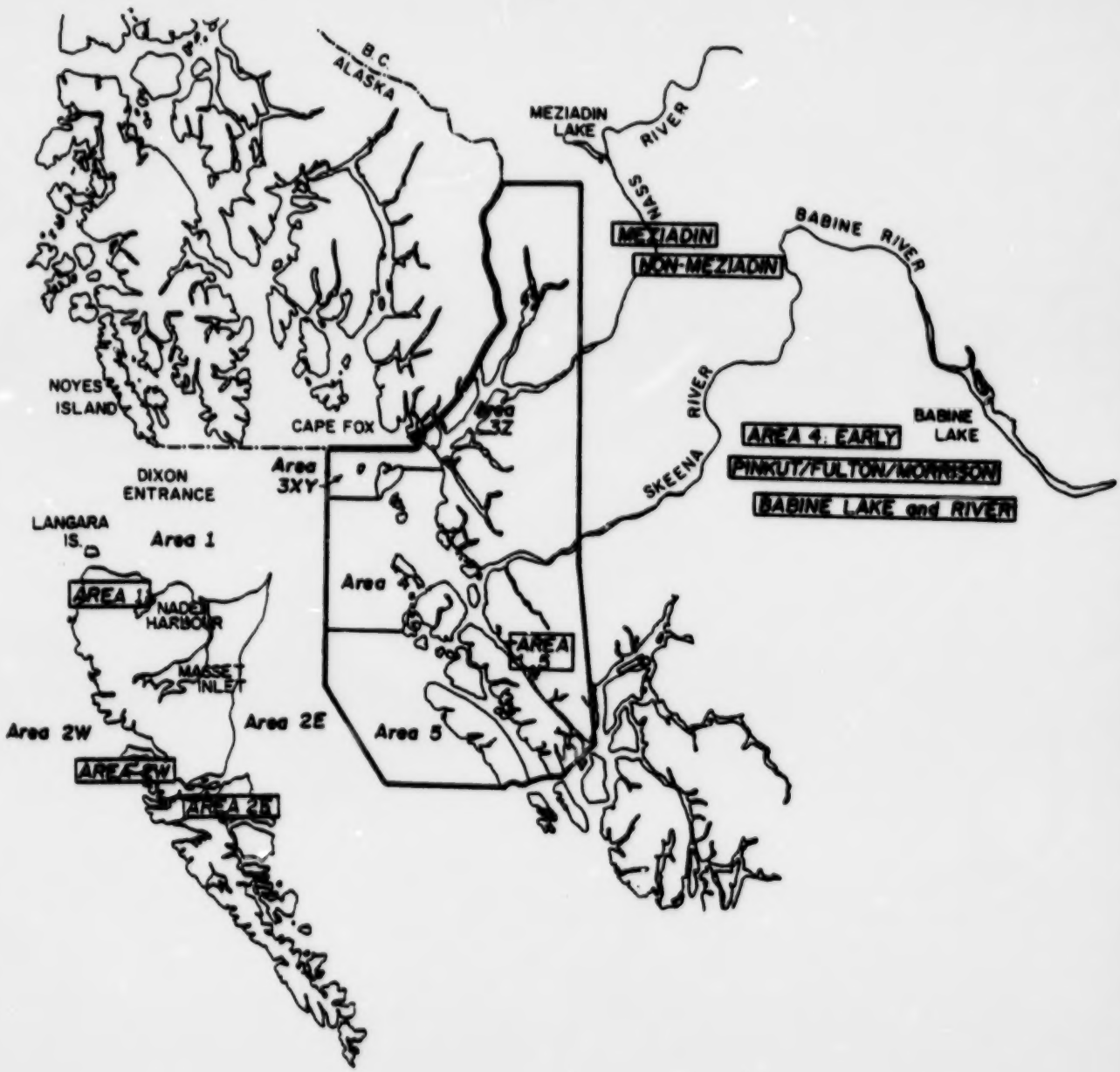


Fig. 3. The major sockeye salmon stocks (boldface type enclosed in boxes) and sockeye salmon fisheries (boldface type not enclosed in boxes) on the Queen Charlotte Islands.

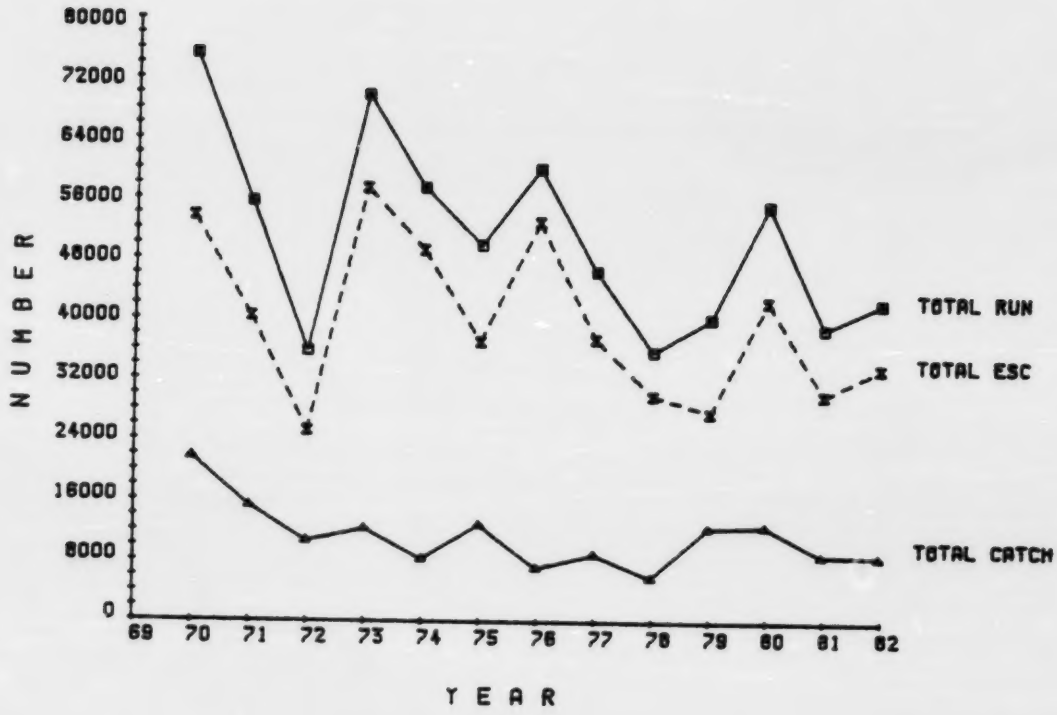


Fig. 4. Catch, escapement and total run size for Queen Charlotte Island sockeye salmon stocks, 1970 to 1982.

Table 1. Stock groups and terminal area run timing for Queen Charlotte Island sockeye stocks.

Stock	Escapement Timing		
	Start	Peak	End
Area 1	late April	mid-May to late June	late July
Area 2W	mid-June	early July	mid-July
Area 2E	late April	mid-May	early June

Table 2. Gear type and sockeye catch timing in major commercial fisheries harvesting Queen Charlotte Islands sockeye stocks (fishery abbreviations in parentheses).

		Catch Timing		
Fishery	Gear Type	Start	Peak	End
Noyes Island, Alaska	seine	early July	mid-July	mid-August
Area 1 (A1)	seine	mid-June	mid-July	mid-August
Area 2W (A2W)	seine	mid-June	late June	early July
Area 2E (A2E)	gillnet	mid-May	late May	mid-June

Table 3. Percentage of the catch in each fishery that is assumed to be of North Coast/Queen Charlotte Islands origin, by month.

	Fishery								
	A1	A2W	A2E	A3XY	A3Z	A4	A5	Noyes	C. Fox
April	85	100	100	100	100	100	100	50	65
May	85	100	100	100	100	100	100	50	65
June	85	90	100	95	100	95	100	65	65
July	80	10/2.5*	100	95	100	100	100	75	75
August	75	0	100	95	100	100	100	60	65
September	75	0	100	100	100	100	100	60	65

* 10% in first half of July, 2.5% in second half.

Table 4. Migration routes and diversion rates for major Queen Charlotte Islands stock aggregations. (Migration time between fisheries is 1/2 week except 1 week where indicated by *)

Stock Name	Routing by Fishery	Proportion of Stock Utilizing each Route
Area 1	Noyes --> A1 (esc)	0.30
	Noyes --> A1 --> A1 (esc)	0.70
Area 2W	Noyes --> A1 -->A2W (esc)	0.65
	A2W --> A2W (esc)	0.35
Area 2E	A1 $\xrightarrow{*}$ A2E --> A2E (esc)	0.70
	A2W $\xrightarrow{*}$ A2E --> A2E(esc)	0.30

Area 1 Sockeye

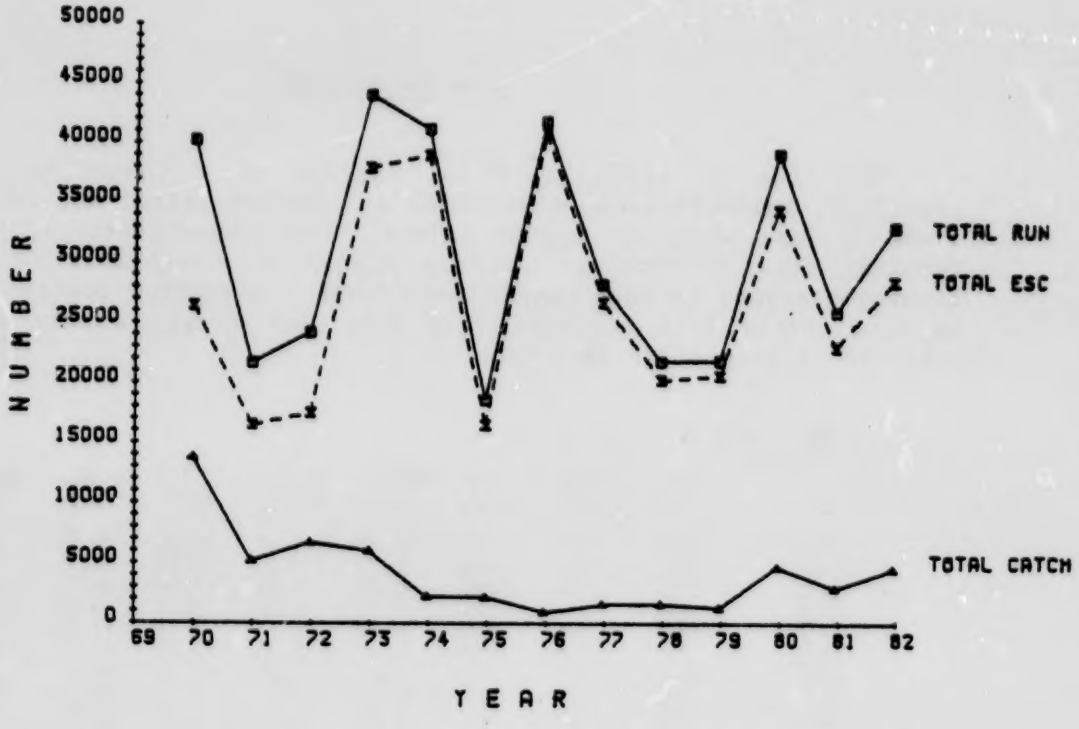
The Area 1 stock aggregation is comprised of the Yakoun, Ain and Awun lake stocks in Masset Inlet, and the Naden River stock in Naden Harbour. It is the largest of the 3 Queen Charlotte Island stock groups, and contains 2 artificially fertilized stock components, the Ain and Awun. When estimated escapement timings for each stock component are weighted by their relative run strengths, the overall timing is tri-modal, with peaks in mid-May, early June and early July, corresponding to Yakoun, Ain/Awun and Naden respectively. Timing information is estimated from historical food fish catch and stream survey data, while escapement estimates are made by foot and aerial surveys. The Masset Inlet stock components provide early-season food fish opportunities for local native fisherman.

STOCK : AREA 1

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH AREA 1	%CATCH NOYES
1970	40280	13780	26500	34.21	94.34	5.64	0.02
1971	21692	5192	16500	23.93	90.53	9.47	0.00
1972	24208	6708	17500	27.71	92.39	7.52	0.08
1973	44034	6034	38000	13.70	94.47	4.45	1.08
1974	41173	2173	39000	5.28	86.53	13.17	0.29
1975	18637	2137	16500	11.47	91.24	8.21	0.55
1976	41814	914	40900	2.19	79.97	14.42	5.61
1977	28297	1547	26750	5.47	94.63	2.51	2.85
1978	21842	1542	20300	7.06	76.89	2.19	20.92
1979	21884	1234	20650	5.64	62.83	12.44	24.73
1980	39087	4687	34400	11.99	78.32	14.18	7.50
1981	25898	2898	23000	11.19	89.02	9.07	1.90
1982	33000	4500	28500	13.64	98.77	0.65	0.58

Over the period 1970-82, total run and total escapement of Area 1 sockeye show no clear trends, but a considerable decline in catch over time is evident between 1970 and 1979. Harvest rates are not particularly high, especially since 1973, and appear to be driven largely by Native food catches, although the Noyes Island fishery obtained a large share of the catch in two years, 1978 and 1979. There is some indication that harvest rates have been increasing in recent years.

The proportion of the catch of Queen Charlotte Islands stocks made up by the Area 1 stock reached 51% in 1982 (compared with a 1970-82 average of 33%), and the Area 1 escapement contribution has risen correspondingly (averaging 78% over 1979-82 compared with 56% over 1970-73). However, this effect is due more to a decline in Area 2E stocks than it is to changes in the Area 1 stock. The entering timing for Area 1 sockeye (at Noyes Island) mimics the tri-modal escapement timing, with peaks mid-May, mid-June and late June.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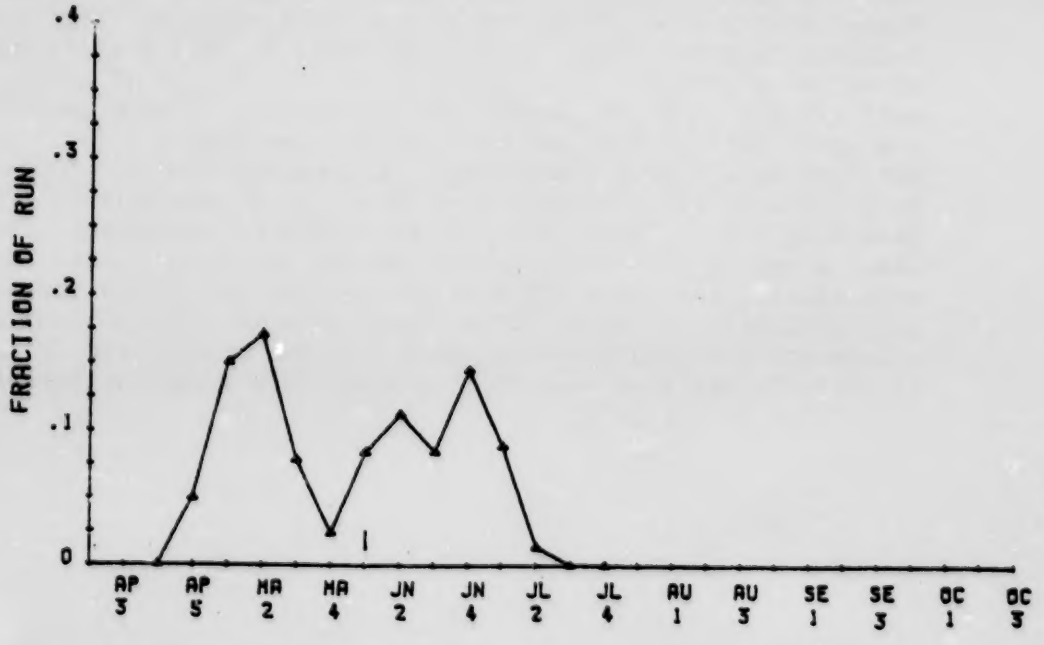
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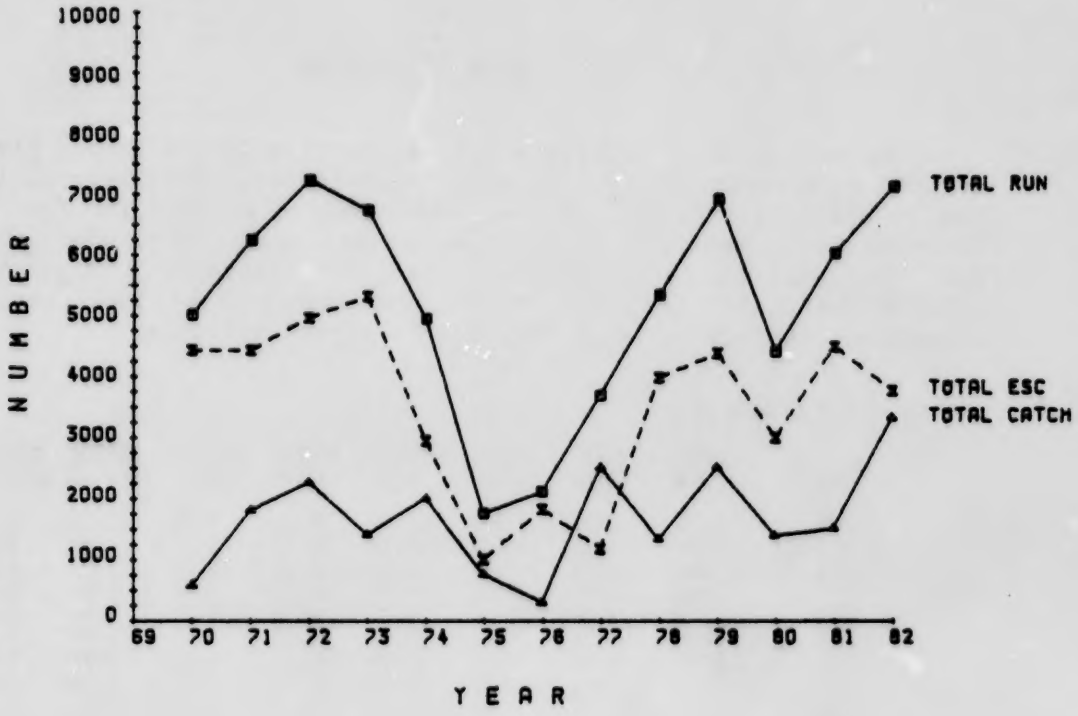
Area 2W Sockeye

The Area 2W stock group is composed of a number of very small producers, which include Mercer Lake on Graham Island and Fairfax Inlet Creek in Tasu Sound on Moresby Island. These runs generally peak in the terminal area in mid-July and are therefore susceptible to commercial fishing pressure in both Canada and Alaska. Migration routes are thought to be directly from the north and west, but there is very little firm evidence in support of this hypothesis.

STOCK : AREA 2W

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH AREA 1	%CATCH AREA 2W	%CATCH NOYES
1970	5098	598	4500	11.72	0.00	41.26	58.73	0.01
1971	6351	1851	4500	29.13	0.00	13.23	86.77	0.00
1972	7360	2310	5050	31.39	0.00	11.79	88.21	0.01
1973	6844	1444	5400	21.10	0.00	5.84	94.09	0.07
1974	5040	2040	3000	40.49	0.00	2.26	97.74	0.00
1975	1799	774	1025	43.05	0.00	2.53	97.17	0.31
1976	2161	305	1856	14.12	0.00	6.17	93.05	0.77
1977	3757	2556	1201	68.02	0.00	0.17	99.76	0.06
1978	5421	1368	4053	25.24	0.00	1.15	93.43	5.42
1979	7006	2554	4452	36.45	0.00	3.06	88.65	8.29
1980	4479	1429	3050	31.91	0.00	9.35	89.36	1.29
1981	6109	1549	4560	25.36	0.00	8.47	90.83	0.70
1982	7213	3382	3831	46.89	88.71	0.15	11.06	0.08

The Area 2W sockeye stock aggregation is particularly difficult to analyze, due to the large but variable component of non-local, primarily Fraser River, fish in the Area 2W fishery. It has been assumed in this analysis that the percentage of the Area 2W catch that is due to local 2W stock is as follows: 90% (June), 10% (first half of July), 2.5% (second half of July) and 0% (August and September). These percentages are the essential determinants of total catch, run size and harvest rate, but do not vary with actual Fraser River sockeye abundance. Hence, in years of large Fraser River stocks, the catch of local Area 2W stocks and the resulting harvest rate, are liable to be over-estimated. Nevertheless, it does appear that exploitation rates on these local stocks can be substantial, averaging 33% over 1970-82 (or 28% if the years 1977 and 1982 are excluded). While catch has remained fairly stable over time, escapement suffered a considerable decline in 1974 and 1975, remained low in 1976-77, but then rebounded to early-1970's levels thereafter.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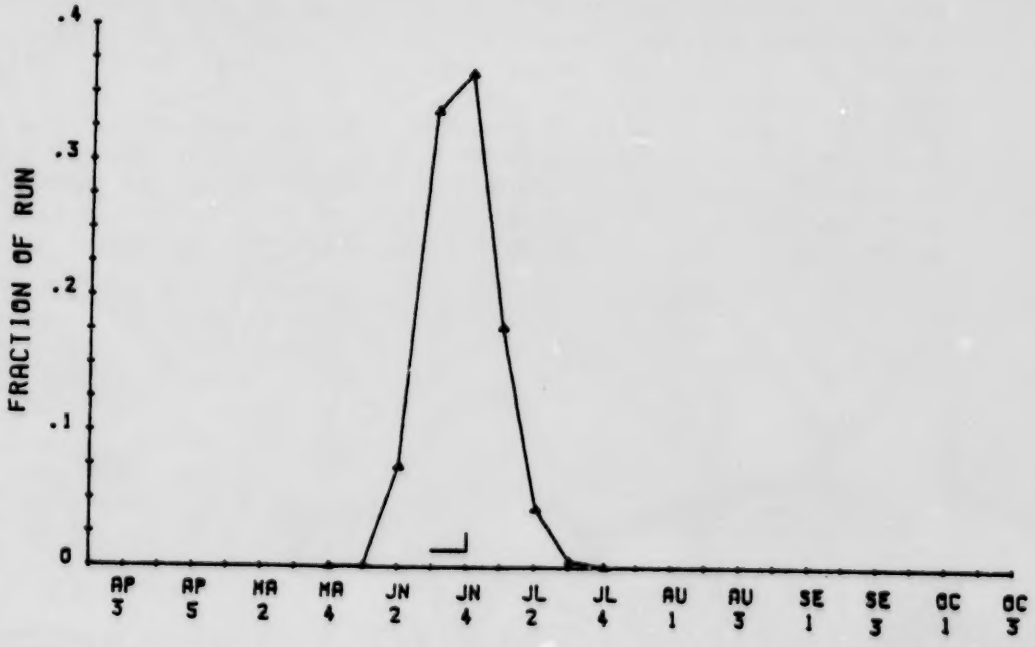
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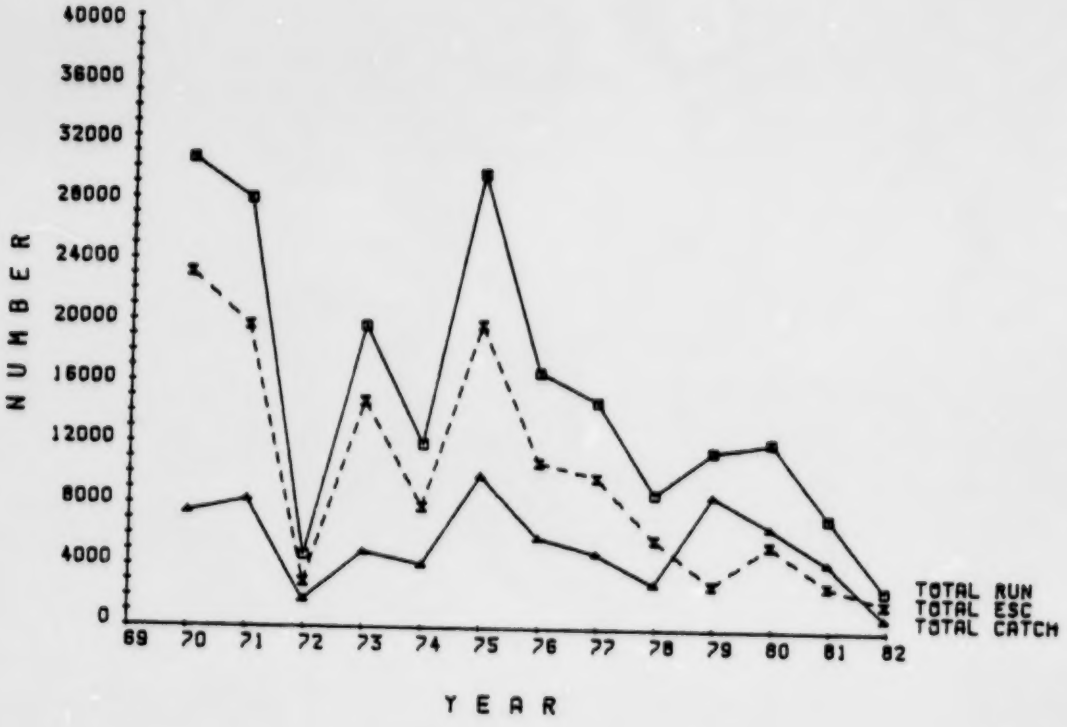
Area 2E Sockeye

The only Area 2E sockeye stock of any size is the Copper River stock, located on Moresby Island just south of Sandspit. This very early sockeye run is utilized primarily by the Skidegate Indian Band for food purposes. Spawning escapement, in tributaries of Skidegate Lake, the nursery area for this stock, is enumerated via foot surveys. Migration route information used in this report represents the best estimates of management biologists, with very little direct evidence.

STOCK : AREA 2E

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH AREA 1	%CATCH AREA 2W	%CATCH AREA 2E
1970	31102	7602	23500	24.44	98.66	0.00	0.00	1.34
1971	28461	8461	20000	29.73	94.56	0.02	0.00	5.43
1972	4800	1800	3000	37.52	100.00	0.00	0.00	0.00
1973	19992	4992	15000	24.97	100.00	0.00	0.00	0.00
1974	12158	4158	8000	34.20	100.00	0.00	0.00	0.00
1975	30169	10076	20093	33.40	99.25	0.00	0.00	0.75
1976	17000	6000	11000	35.29	100.00	0.00	0.00	0.00
1977	15054	5004	10050	33.24	99.92	0.00	0.08	0.00
1978	9000	3000	6000	33.34	100.00	0.00	0.00	0.00
1979	11875	8875	3000	74.76	99.99	0.00	0.01	0.00
1980	12487	6800	5687	54.46	100.00	0.00	0.00	0.00
1981	7501	4501	3000	60.01	99.98	0.02	0.00	0.00
1982	2730	880	1850	32.25	100.00	0.00	0.00	0.00

The state of Area 2E sockeye stocks is clearly displayed in the accompanying plot of total run, catch and escapement over time. The total run has declined from a 1970-76 average of 20,500 to a 1977-82 average of 9,800, while average escapement has declined even more drastically, from 14,400 to 4,900. The annual harvest rate over 1970-78 remained fairly stable, averaging 32%, but has risen to an average 55% for the period 1979-82. Catch of Area 2E sockeye is almost entirely in the local native food fishery, with very small occasional Area 1 and Area 2W interceptions; no Area 2E commercial fishery has operated since the nearly 1970s. The entering timing, with landfall assumed to be in either Area 1 or Area 2W, is very early, with a peak during the first week of May.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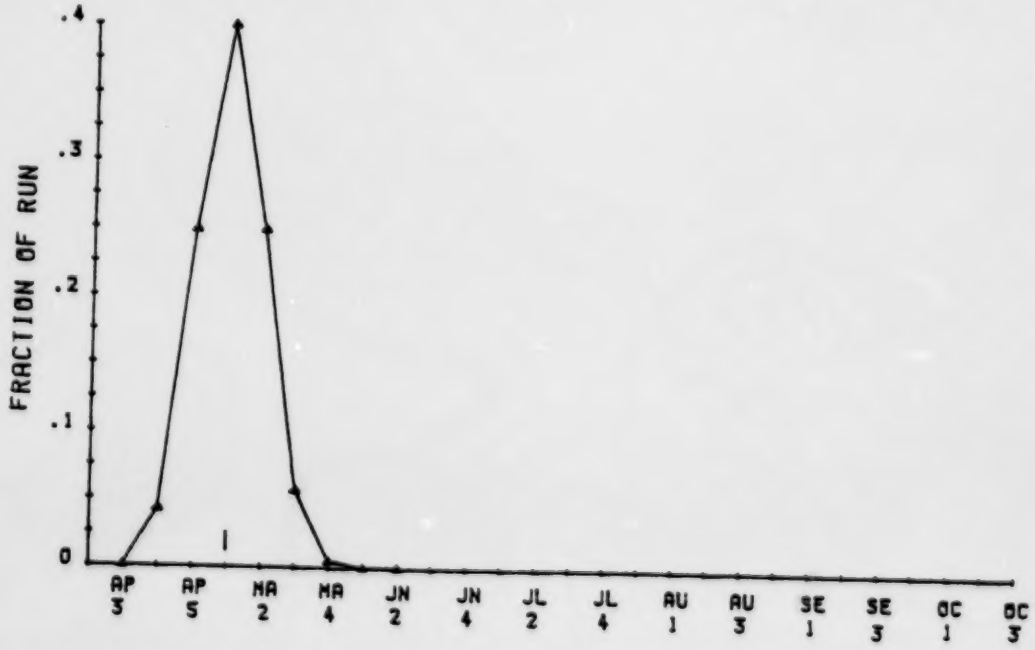
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North Coast

This area, comprising statistical areas 3-5, encompasses the drainages of the Nass and Skeena Rivers and the adjacent coastal area stretching from the U.S./Canada border to the southernmost tips of Pitt and Banks Islands. The Skeena and Nass Rivers are the second and third largest B.C. rivers respectively, with their entire length in B.C. The coastal portion of Area 3 and 4 is characterized by an outer chain of islands surrounding Chatham Sound, a large open body of water. Area 5 is a more complex series of islands and channels (Fig. 5).

The major sockeye stocks in the area are from Babine Lake in the Skeena watershed and Meziadin Lake in the Nass watershed. These lake systems lie approximately 375 and 175 kilometres from the ocean, respectively, and together account for over 85 percent of the sockeye production from the North Coast. In addition to these systems there are approximately twenty other significant sockeye producers in Area 4, and five others in Area 3, while Area 5 has 12-18 small coastal producers. For the purpose of this assessment, six stock groups have been assembled, as shown in Table 5.

The two Nass stock groups are self-explanatory and allow for the individual assessment of the major Nass sockeye producer, the Meziadin system. There are no documented timing or migration route differences between these groups.

The three Skeena groups are defined primarily by timing and secondarily, by size of sub-stocks and spawning locations. The "early runs" are small stocks bound for both Babine and non-Babine systems; a small component of this group might be considered to have somewhat later timing, but because of the size of these stocks and their common unenhanced status they have been grouped with the "early run" stocks. The Pinkut/Fulton/Morrison group is a middle timing assemblage that includes the two Babine Lake spawning channel systems as well as the Morrison system, another tributary of Babine Lake. The Babine Lake and River group can be considered as a late timing stock aggregation and includes outlet river spawners and lake spawners (fish that were counted through the Babine fence but were unaccounted for in tributary streams).

The major approach routes for North Coast stocks are assumed to be via Dixon Entrance (Area 1), with a component of all stocks passing Noyes Island, Alaska and/or Langara Island on the Queen Charlotte Islands. Within the inside area the major approaches to the spawning rivers are either (i) from the North through Area 3 (3X, 3Y) and Cape Fox, Alaska, or (ii) from the west, through Areas 4 and 5 (Table 6).

Past tagging studies, including the recent International Tagging Program, as well as local fishery officers and management biologists, provided much of this migration route and timing information.

For the purposes of this assessment, commercial fisheries have been grouped primarily by their common impacts on the stock aggregations

identified. Therefore, although the fisheries in the 3X, 3Y group are widely dispersed and comprise both seine and gillnet fisheries, they are considered as one fishery because of their common impact on Nass and Skeena sockeye stocks. Seven major fisheries are identified (Table 7).

In most fisheries of relevance to North Coast stocks, not all the harvest can be considered to arise from 'local' stocks. Month-by-month interception rates for each fishery are shown in Table 8, representing the percentage of the harvest that is assumed to be North Coast/Queen Charlotte Islands fish. This, therefore, attempts to remove U.S. and Fraser River fish from the North Coast analysis. Interception rates are based on tagging study results and biologists' estimates.

In addition to these commercial fisheries, Native food fisheries also harvest sockeye in all three statistical areas. In Area 3, there is a coastal food fishery based out of Kincolith and Port Simpson and non-tidal fisheries at Greenville, Canyon City and Aiyansh on the Nass River. In Area 4, there is again a coastal fishery as well as numerous non-tidal fisheries on the Skeena River near Terrace, Hazelton and Smithers. The Area 5 food fishery is entirely coastal and is based out of Kitkatla.

Since the early 1970's a number of trends in both the commercial fisheries and the stock status of sockeye have been evident.

Enhanced Babine stocks are becoming the dominant contributor to the commercial fishery while wild stocks, particularly those with late timing, seem to be declining. This has caused severe problems for fishery managers trying to harvest the available enhanced returns while attempting to maintain wild stocks.

Commercial fishing power has generally been increasing, with fisheries at Noyes and Langara Islands most exemplifying this trend. Without recent restrictions in fishing times in these two locations escapements to inside fisheries would have been greatly reduced.

Fishery effort, particularly by seines, has increased very markedly in recent years in Areas 3 and 4 due mostly to very restricted fishing times in other traditional seine fishing areas. This has resulted in increased interceptions of Skeena and Nass sockeye before they enter terminal fishing areas.

The aggregated run, catch and escapement results for the North Coast (Areas 3-5), obtained by summing over the 6 stocks described below, are shown in Fig. 6. For the North Coast as a whole, these results show a somewhat increasing trend in each of run, catch and escapement, although there is considerable year-to-year variability.

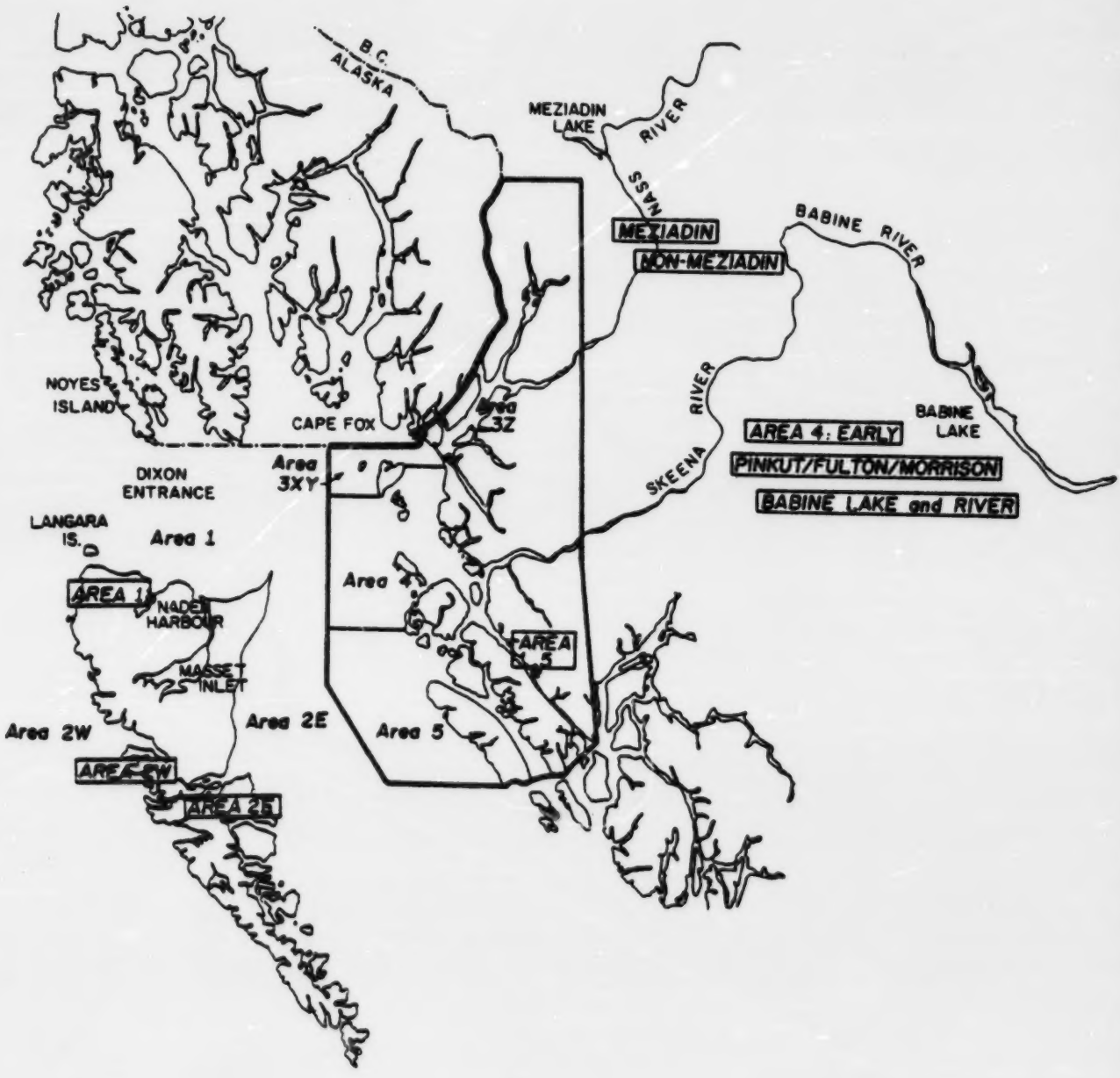


Fig. 5. The major sockeye salmon stocks (boldface type enclosed in boxes) and sockeye salmon fisheries (boldface type not enclosed in boxes) on the North Coast.

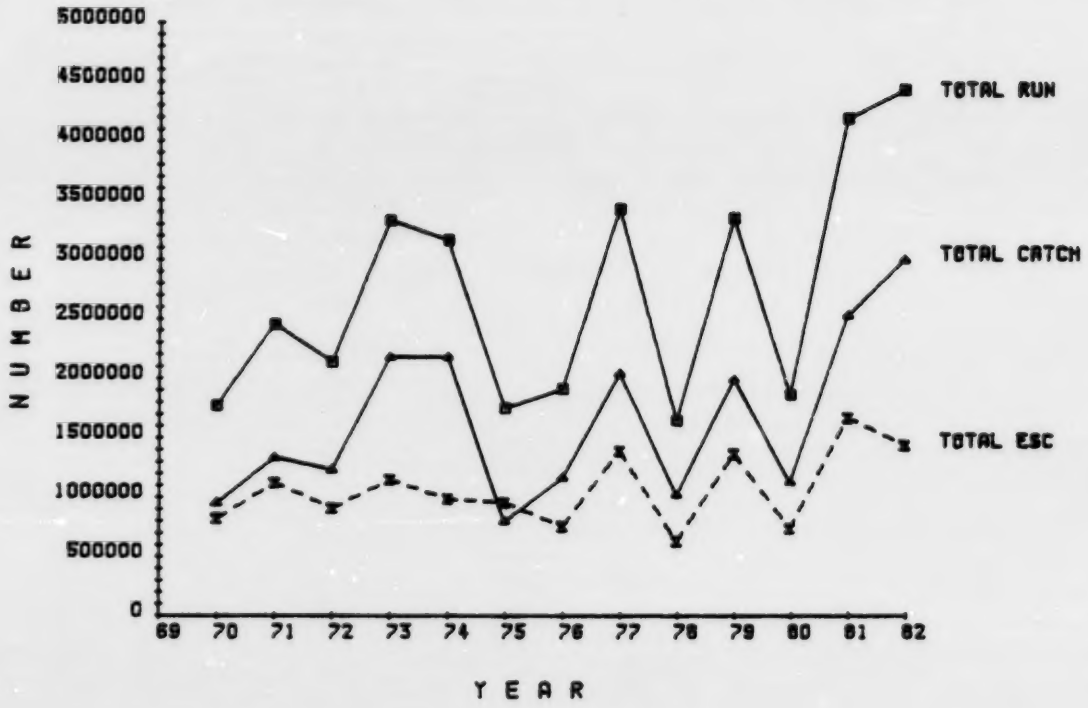


Fig. 6. Catch, escapement and total run size for North Coast sockeye salmon stocks, 1970 to 1982.

Table 5. Stock groups and terminal area run timing for North Coast sockeye stocks.

Stock	Escapement Timing		
	Start	Peak	End
Area 3/Nass/Meziadin	mid-May	late June	late July
Area 3/Nass/Non-Meziadin	mid-May	late June	late July
Area 4/Skeena/Early Runs	mid-May	mid to late June	late July
Area 4/Skeena/Pinkut-Fulton-Morrison	mid-June	mid-July	early August
Area 4/Skeena/Babine Lake & River	late June	late July	mid-August
Area 5/All stocks	mid-May	mid-June	mid-July

Table 6. Migration routes and diversion rates for major North Coast stock groups. (Migration time between fisheries is 1/2 week except 1 week where indicated by *)

Stock Name	Routing by Fishery	Proportion of Stock Utilizing each Route
Area 3 Meziadin		
Area 3 Non-Meziadin		
	Noyes $\overset{*}{\rightarrow}$ Fox --> A3Z	0.25
	Noyes --> A3XY --> A3Z	0.35
	A1 --> A3XY --> A3Z	0.40
Area 4 Early Run		
Area 4 Pinkut/Fulton/Morrison		
Area 4 Babine Lake and River		
	Noyes $\overset{*}{\rightarrow}$ Fox --> A3XY --> A4	0.15
	Noyes --> A3XY --> A4	0.25
	Noyes --> A1 $\overset{*}{\rightarrow}$ A4	0.20
	A1 $\overset{*}{\rightarrow}$ A4	0.30
	A1 $\overset{*}{\rightarrow}$ A5 --> A4	0.10
Area 5		
	Noyes $\overset{*}{\rightarrow}$ A4 --> A5	0.80
	A1 $\overset{*}{\rightarrow}$ A5	0.20

Table 7. Gear type and sockeye catch timing for the major fisheries harvesting North Coast sockeye stocks.

Fishery	Gear Type	Catch Timing		
		Start	Peak	End
Noyes Island, Alaska	seine	early July	mid-July	mid-August
Cape Fox, Alaska	gillnet	mid-June	early July	mid-August
Area 1 (A1)	seine	mid-June	mid-July	mid-August
Area 3X,3Y (A3XY)	seine and gillnet	early July	late July	mid-August
Area 3Z (A3Z)	seine and gillnet	mid-June	late June	early August
Area 4 (A4)	gillnet	early July	mid to late July	mid-August
Area 5 (A5)	seine and gillnet	late June	mid to late July	mid-August

Table 8: Percentage of the catch in each fishery that is assumed to be of North Coast/Queen Charlotte Islands origin, by month.

	Fishery								
	A1	A2W	A2E	A3XY	A3Z	A4	A5	Noyes	C. Fox
April	85	100	100	100	100	100	100	50	65
May	85	100	100	100	100	100	100	50	65
June	85	90	100	95	100	95	100	65	65
July	80	10/2.5*	100	95	100	100	100	75	75
August	75	0	100	95	100	100	100	60	65
September	75	0	100	100	100	100	100	60	65

* 10% in first half of July, 2.5% in second half.

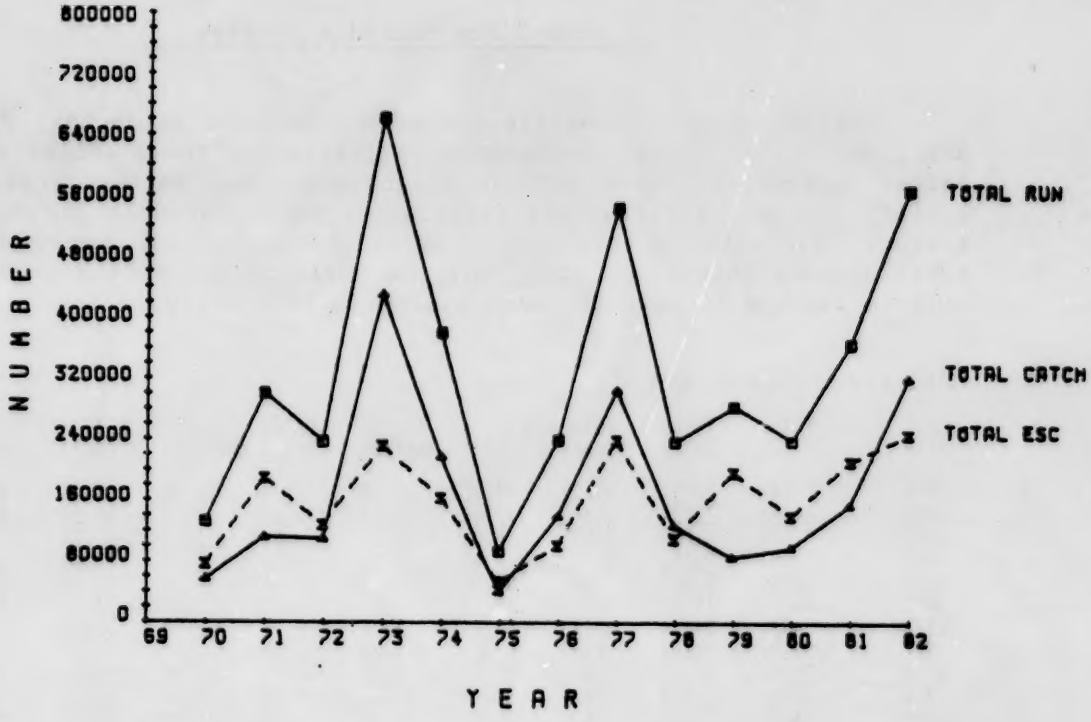
Area 3 Meziadin Sockeye

The Meziadin Lake sockeye stock is the largest single contributor to the Nass sockeye run. Approximately two-thirds of Meziadin spawning takes place in the lake itself while the remaining third is divided between Hanna and Tintina Creeks. A fishway, located about one-quarter of the way up the mile-long Meziadin River was built in 1966 to bypass a series of falls and has provided a facility for enumerating this stock. Meziadin sockeye first enter the terminal fishing area in mid-May, but are not usually available in sufficient numbers for harvest until mid-June. The run peaks from late June to early July and is present in the fishing area until late July. A test fishery on the lower Nass River provides an in-season assessment of the strength of this stock.

STOCK : AREA 3 MEZIADIN

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH AREA 1	%CATCH AREA 3XY	%CATCH AREA 3Z	%CATCH NOYES	%CATCH C.FOX
1970	133841	56763	77078	42.41	10.65	3.34	15.40	65.45	0.37	4.79
1971	304618	112944	191674	37.08	5.59	4.65	12.99	59.26	0.01	17.49
1972	240108	110583	129525	46.06	5.59	3.01	16.46	62.53	1.61	10.81
1973	671391	436764	234627	65.05	2.15	0.34	3.77	86.60	1.19	5.94
1974	385348	220089	165259	57.11	5.59	0.63	14.11	76.44	0.09	3.15
1975	94280	40185	54095	42.62	9.53	1.15	7.76	76.04	0.26	5.26
1976	242997	140567	102430	57.85	15.04	0.22	1.99	68.69	0.37	13.71
1977	350871	308520	242351	56.01	6.86	0.15	7.05	77.33	0.74	7.87
1978	240165	129147	111018	53.77	9.07	0.12	9.52	73.16	1.03	7.09
1979	286807	86807	200000	30.27	17.46	1.50	33.98	18.75	15.13	13.17
1980	241767	99767	142000	41.26	18.32	3.41	26.96	17.33	20.91	13.09
1981	370442	156249	214193	42.18	9.75	1.86	23.30	54.39	3.01	7.69
1982	574698	324698	250000	56.50	8.16	0.37	17.09	68.71	2.14	3.54

On average, over the period 1970-82, Meziadin sockeye comprised approximately 80% of both total run and total escapement of Area 3 stocks. No major trends are apparent for run, catch, escapement or harvest rate during the period 1970-82. However, some change is apparent in fishing patterns over time, with the fraction of Meziadin fish caught in the 3XY fishery showing an increase. The percentage of catch harvested in Alaska, at Noyes Island and Cape Fox, appears to be driven by the Area 3 fisheries. For example, in 1979 and 1980, restrictions on Area 3Z fishing resulted in less than 20% of Meziadin catch being harvested in that area while 28-34% was caught in Alaska. The entering run timing for Meziadin sockeye, at Noyes Island or Langara, peaks during the third week of June. Fifty percent of the run has entered by the 4th week of June, on average, although this can vary by up to 2 weeks from year to year.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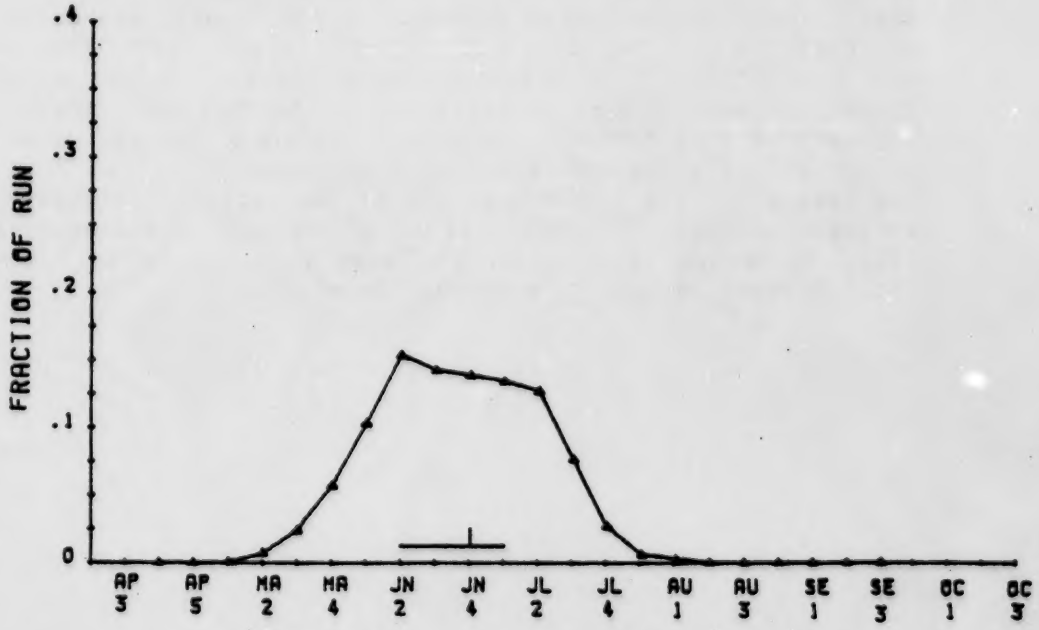
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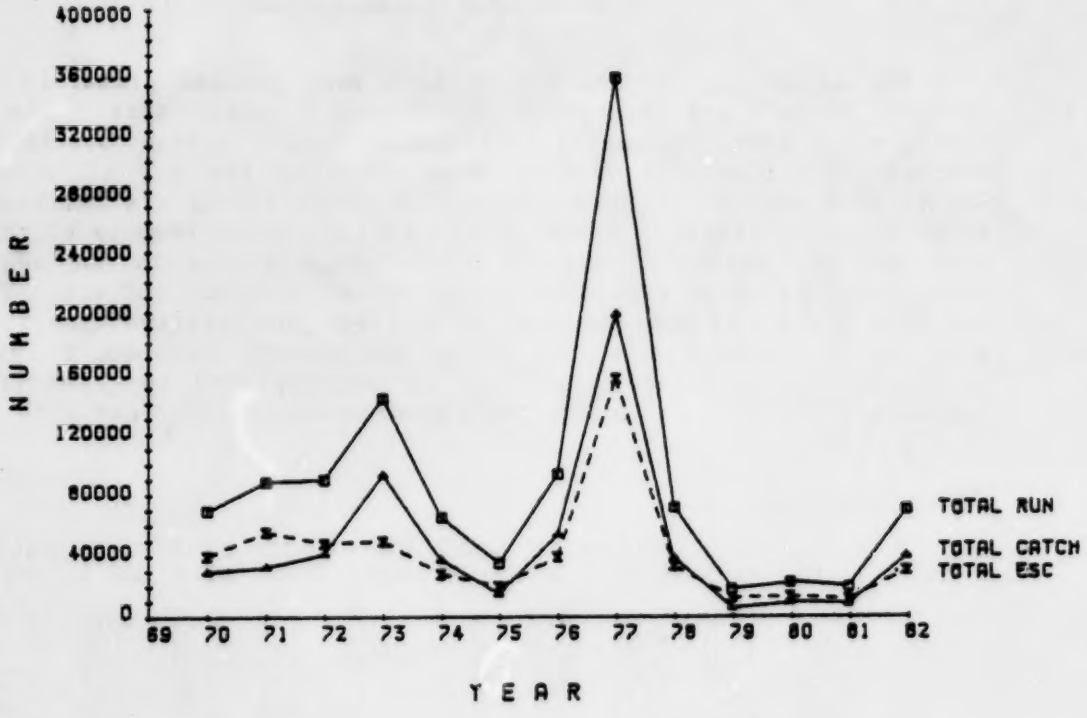
Area 3 Non-Meziadin Sockeye

This stock group consists almost entirely of Damdochax, Fred Wright and Bowser Lake stocks. Escapement estimates for these stocks are made by aerial surveys, in-river carcass counts and scale pattern analysis. The quality of data is definitely inferior to that available for the Meziadin system. There is no information to indicate that any timing differences exist between this stock group and the Meziadin stock, and therefore they will be assumed to have the same timing in this analysis.

STOCK : AREA 3 NON-MEZIADIN

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH AREA 1	%CATCH AREA 3XY	%CATCH AREA 3Z	%CATCH NOYES	%CATCH C.FOX
1970	70549	29924	40625	42.41	10.65	3.34	15.40	65.45	0.37	4.79
1971	89634	33234	56400	37.08	5.59	4.65	12.98	59.26	0.01	17.49
1972	91193	42002	49191	46.06	5.59	3.01	16.46	62.53	1.61	10.81
1973	144957	94302	50655	65.05	2.15	0.34	3.77	86.60	1.19	5.94
1974	66321	37877	28444	57.11	5.59	0.63	14.11	76.44	0.09	3.15
1975	35741	15234	20507	42.63	9.53	1.15	7.77	76.03	0.26	5.27
1976	94831	54856	39975	57.85	15.04	0.22	1.99	68.69	0.36	13.71
1977	359208	201188	158020	56.01	6.86	0.15	7.05	77.33	0.74	7.87
1978	72674	39082	33592	53.77	9.07	0.12	9.52	73.16	1.03	7.10
1979	18528	5608	12920	30.27	17.46	1.50	33.98	18.76	15.13	13.16
1980	23011	9490	13521	41.25	18.34	3.41	26.97	17.31	20.88	13.10
1981	19850	8375	11475	42.19	9.75	1.86	23.28	54.42	3.01	7.68
1982	71420	40350	31070	56.50	8.16	0.37	17.08	68.71	2.14	3.54

Non-Meziadin Area 3 sockeye stocks show a declining trend in escapement over the period 1970-82, although the harvest rate and exploitation pattern are similar to those of the Meziadin stock (due to assumptions of identical escapement timing and diversion rates). While harvest rates on Area 3 stocks were reduced somewhat in poor years, fisheries management is oriented towards the dominant Meziadin stocks, and this fact, together with the difficulty in differentiating between stocks in this mixed stock fishery, leads to over-exploitation of non-Meziadin stocks, particularly in years of high Meziadin returns. Comparing the period 1970-76 with the period 1978-82, the non-Meziadin contribution declined from 22% to 11% of the Area 3 run and from 23% to 10% of the corresponding escapement. These averages exclude the atypically large run, catch and escapement levels of 1977, which are likely due, at least in part, to an over-allocation of total Nass escapement to non-Meziadin stocks.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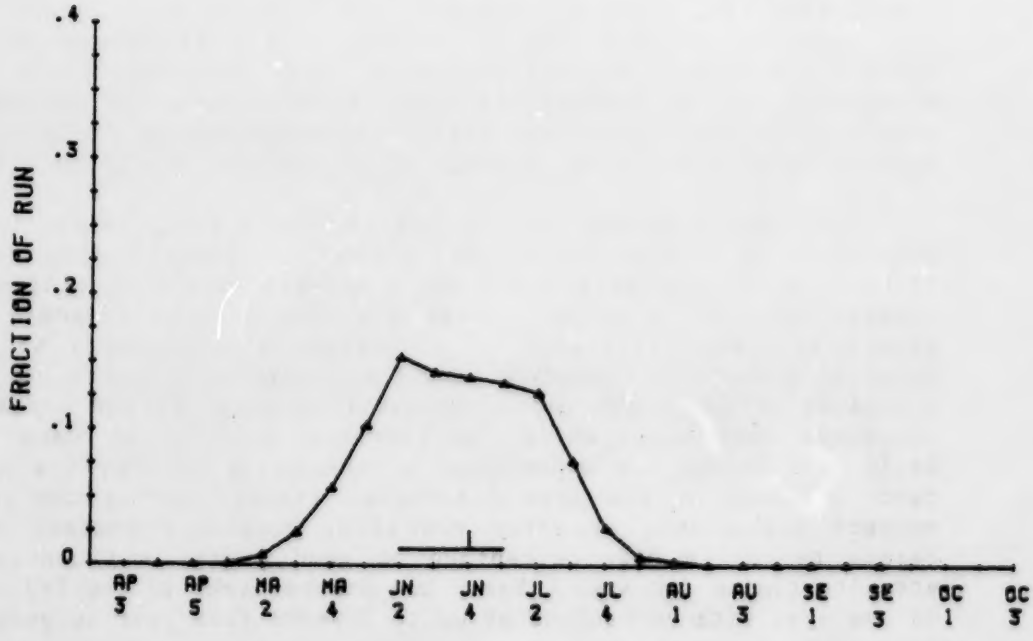
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OC 1
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Area 4 Early Run Sockeye

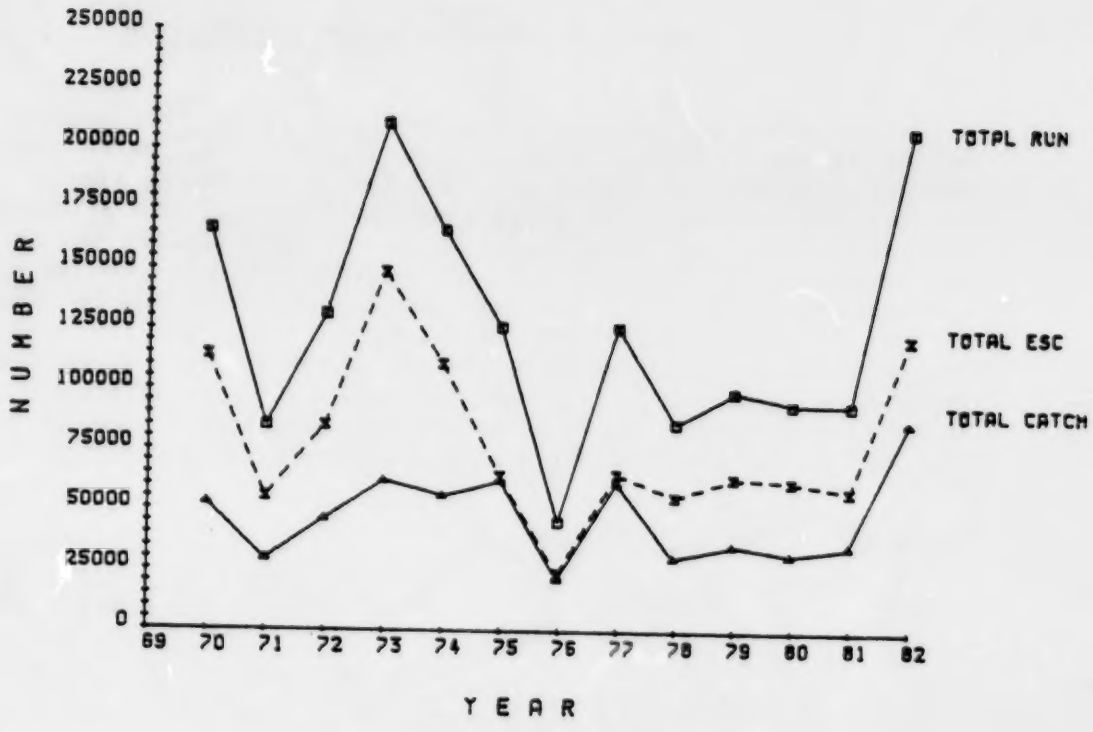
The early runs to the Skeena have been grouped primarily by timing and are distributed throughout the Skeena drainage area. The Lakelse, Alastair, Nanika, McDonnell and Babine small stream stocks all peak through the commercial fishing area prior to the end of June. Other stocks such as the Kitsumkalum and Club Creek stocks are believed to have slightly later timing but were placed in this group because of their small size and the desire to keep all non-Babine stocks in one aggregation. Escapement estimates were obtained by aerial and foot surveys. The timing for this group has been weighted to reflect the relative contributions of each of the component stocks (based on average escapement levels from 1970-82). As a group this stock is not impacted very heavily by the commercial fishery, since the run's peak usually occurs prior to the start of the fishery.

STOCK : AREA 4 EARLY RUN

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH AREA 1	%CATCH AR 3XY	%CATCH AREA 4	%CATCH AREA 5	%CATCH NOYES	%CATCH C.FOX
1970	166729	52554	114175	31.52	16.18	7.98	4.90	55.71	10.67	0.32	4.24
1971	84914	29614	55300	34.87	18.01	10.98	3.63	43.27	2.52	0.14	21.45
1972	130981	46005	84976	35.12	13.55	7.82	8.74	46.37	4.20	1.52	17.80
1973	210832	61953	148879	29.38	20.18	1.37	3.36	51.81	0.67	2.44	20.16
1974	166466	55804	110662	33.52	21.99	2.54	9.78	52.35	1.32	2.08	9.95
1975	126338	62152	64186	49.20	10.74	3.70	6.00	71.26	1.36	0.40	6.54
1976	45363	21524	23839	47.45	15.21	1.43	2.93	40.28	5.22	1.90	33.02
1977	126301	61217	65084	48.47	11.35	0.98	7.27	55.79	1.43	2.23	20.95
1978	86018	30393	55625	35.33	49.96	0.32	11.32	23.84	1.87	3.41	9.28
1979	99215	35699	63516	35.98	23.77	3.14	6.18	46.60	3.21	4.59	12.52
1980	93892	31830	62062	33.90	47.63	6.60	4.50	19.22	0.97	9.06	12.02
1981	93713	35545	58168	37.93	13.37	5.95	12.10	50.32	5.74	2.18	10.33
1982	208126	86580	121546	41.60	26.13	0.85	12.01	46.64	3.66	2.61	8.10

During the period 1970-82, the 'Early Run' stock aggregation comprised, on average, 10% of overall Area 4 escapement but just 6% of overall run size. The difference in these two proportions reflects the management aim of maintaining lower harvest rates on unenhanced stocks. However, the fraction of the Area 4 run comprised of early run stocks has declined over time, to an average of just 4% for the period 1979-82.

The overall harvest rate on Area 4 'early runs' peaked in the 1975-77 period, with average rates as follows: 1970-73, 33%; 1974-78, 43%; 1979-82, 37%. The Area 4 fishery's harvest rate (calculated as 'overall harvest rate' x '% catch in Area 4') lies between 15-20% for all years except 1975 and 1977; this is consistent with attempts to minimize the terminal commercial fishery's impact on these early runs. In general, the fractions of Early Run catch harvested in Area 3XY and Noyes Island show increases over time, while the fraction obtained at Cape Fox shows a decline. Unlike the experience of the early 1970's, the percentage of catch obtained in the Area 4 terminal fishery during the years 1977-82 appears independent of early run size, depending instead on the total Skeena return (a high percentage in good years, and conversely). The entering timing for Area 4 Early Run stocks peaks in the 3rd week of June, on average, with variations of up to 2 weeks from year to year.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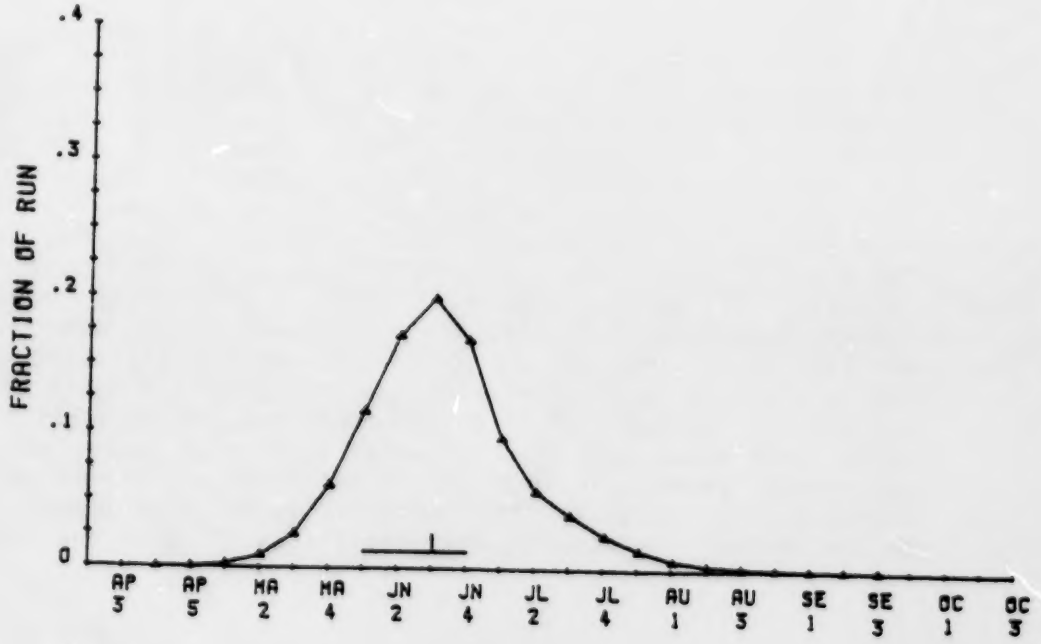
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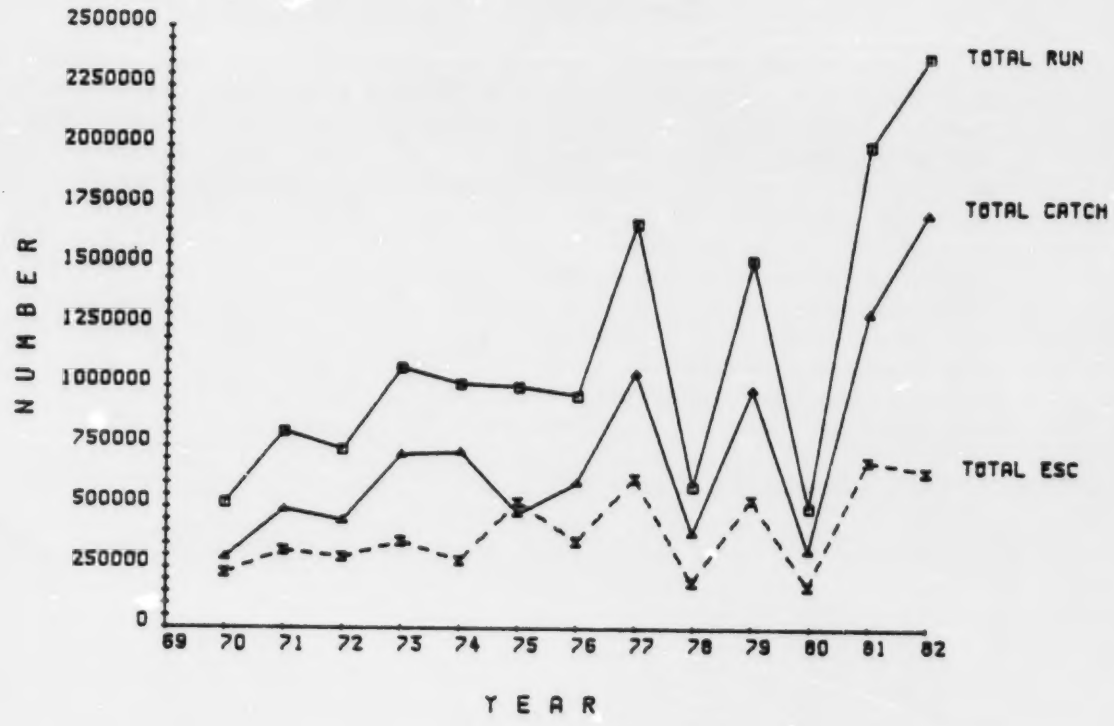
Area 4 Pinkut/Fulton/Morrison Sockeye

This stock aggregation contains Pinkut and Fulton, the two enhanced Babine stocks, together with the Morrison stock, which originates in another tributary of Babine Lake and has a run timing similar to that of the enhanced stocks. The three spawning channels, two at Fulton and one at Pinkut, have been in operation since the late sixties and are currently the major contributors to the commercial fishery. As a result, the unenhanced Morrison stock has been heavily exploited and is currently in a depressed state. Escapement estimates for this group are via counting fences on most of the spawning channel stocks and visual estimates on the remainder. Timing for this stock aggregation is calculated as an average of estimated Pinkut, Fulton and Morrison escapement timing, weighted by the relative stock strengths during the period of 1970-82.

STOCK : AREA 4 PINKUT/FULTON/MORRISON

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH AREA 1	%CATCH AR 3XY	%CATCH AREA 4	%CATCH AREA 5	%CATCH NOYES	%CATCH C.FOX
1970	518447	291190	227257	56.17	5.82	5.77	6.14	64.59	12.58	0.68	4.42
1971	812939	490954	321985	60.39	6.32	3.03	6.33	74.28	4.30	0.27	5.46
1972	740298	445169	295129	60.13	4.86	4.92	9.10	64.42	5.16	3.56	7.97
1973	1077821	717703	360119	66.59	4.21	1.41	4.59	79.58	0.84	4.10	5.28
1974	1009770	730364	279406	72.33	4.24	0.72	14.30	74.10	0.41	2.97	3.26
1975	998730	475380	523349	47.60	11.45	2.43	11.62	66.49	3.36	3.20	1.44
1976	962031	602240	359791	62.60	8.21	1.04	8.10	66.60	1.26	8.86	5.92
1977	1678603	1057380	621222	62.99	6.27	1.69	17.07	58.07	1.58	9.54	5.77
1978	589840	396108	193732	67.16	12.91	0.52	12.47	53.78	2.73	6.71	10.87
1979	1528054	991624	536430	64.89	7.23	2.46	8.75	66.19	1.11	11.75	2.53
1980	502681	324368	178313	64.53	13.43	4.73	11.09	41.89	2.08	20.31	6.48
1981	2006417	1308716	697701	65.23	4.35	5.78	11.10	69.17	1.00	6.34	2.26
1982	2375914	1722015	653900	72.48	7.07	1.83	10.47	67.79	2.51	5.82	4.51

Total returns of the Pinkut/Fulton/Morrison stock aggregation have increased over time, but the degree of variability appears to have risen as well. Catch and escapement levels have both increased correspondingly, while the overall harvest rate shows no clear trend. (It should be noted, however, that substantial increases in Pinkut and Fulton escapements mask the declining trend in the Morrison stock component.) The Pinkut/Fulton/Morrison contribution to total Area 4 run and escapement do not show any major trends over time, averaging 49% and 47% respectively over the period 1970-82. The Area 4 terminal fishery is the primary tool available to manage Skeena River stocks, and therefore is most responsive to the run strength each year. Run reconstruction results show that in recent years the Area 4 fishery harvest rate has been lower in times of poor returns, reflecting management efforts to reach escapement goals. On the other hand, these goals have been surpassed in several years, due to constraints on harvest rates necessary for conservation of unenhanced stocks. The incoming run timing for the Pinkut/Fulton/Morrison aggregation is centred on the second week of July, with variations of up to one week.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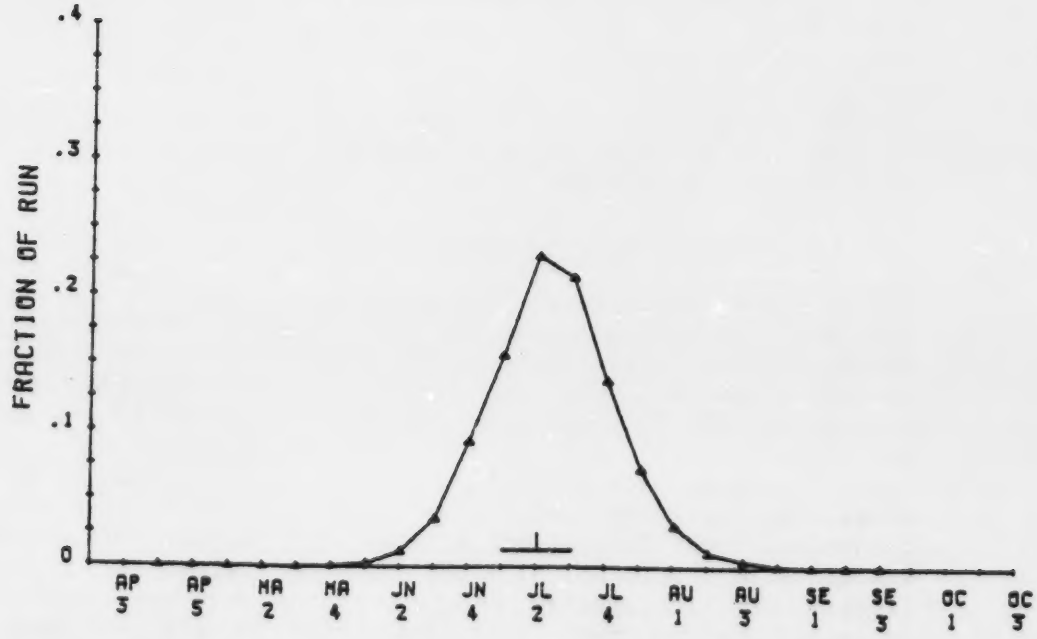
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Area 4 Babine Lake and River Sockeye

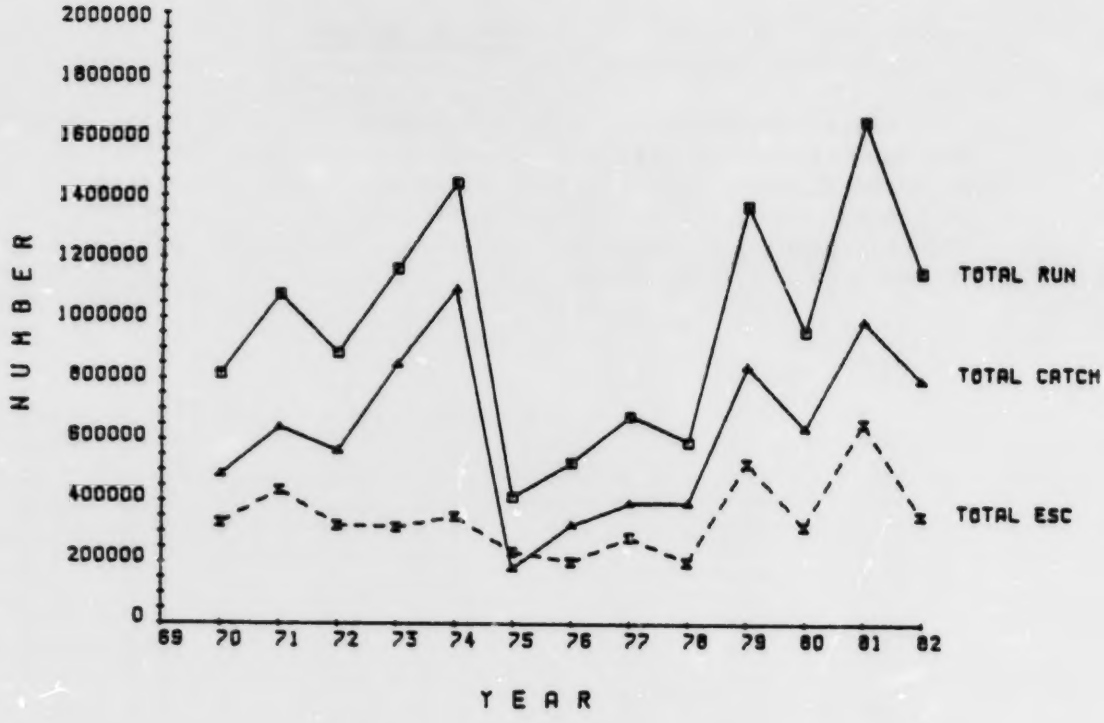
This stock group is generally regarded as a late sockeye run, with its peak occurring well into the Skeena pink run. It contains only the Babine Lake and River stocks, which have several notable differences between them. The Babine Lake stock has been an enigma to fishery biologists since it was first discovered and has become a particular concern in light of recent estimates of its size. The Lake spawning escapement is calculated as the difference between (i) the Babine Fence count of total sockeye entering the Babine system and (ii) the number of fish accounted for in all tributary systems. The Babine River stock, on the other hand, is estimated using a Peterson mark-recapture method and has been well documented since the late forties. Due to the uncertainties surrounding the composition and timing of the Lake stock, the River timing estimate has been used to represent this group.

STOCK : AREA 4 BABINE LAKE AND RIVER

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH AREA 1	%CATCH AR 3XY	%CATCH AREA 4	%CATCH AREA 5	%CATCH NOYES	%CATCH C.FOX
1970	826926	492404	334522	59.55	5.01	4.47	6.15	65.40	13.51	1.65	3.82
1971	1092065	649815	442250	59.50	6.56	2.94	7.64	73.27	4.67	0.83	4.08
1972	898009	571433	326576	63.63	4.19	3.85	9.92	63.46	5.93	6.30	6.34
1973	1179683	858510	321173	72.77	3.14	1.38	4.63	80.32	1.54	5.47	3.51
1974	1468341	1111604	356737	75.70	3.56	0.51	14.48	71.73	0.43	5.51	3.77
1975	422967	184271	238696	43.57	13.48	4.32	10.44	62.87	4.58	2.32	1.99
1976	536546	328991	207555	61.32	8.66	1.11	8.06	68.50	1.73	7.18	4.75
1977	689694	400520	289175	58.07	7.71	2.58	18.26	51.64	2.47	11.31	6.04
1978	604414	398944	205469	66.01	12.43	0.59	16.46	44.17	3.78	11.16	11.41
1979	1389412	855088	534324	61.54	8.35	3.60	8.13	64.34	1.10	12.05	2.43
1980	973388	648699	324689	66.64	12.23	6.16	11.26	30.73	2.55	31.37	5.70
1981	1675991	1007552	668439	60.12	5.42	9.71	10.33	61.72	1.00	9.12	2.70
1982	1171250	809455	361795	69.11	8.32	2.01	13.31	59.81	3.16	8.74	4.65

The Babine Lake and river stock has consistently comprised a large fraction of total Area 4 run, catch and escapement, although there is significant variability in its contribution (ranging from a low of 27% of the Area 4 run in 1975 to a high of 62% in 1980). The Lake and River contribution to Area 4 escapement shows no real trend, while its contribution to catch has decreased substantially, from an average of 48% in 1970-76 to an average of 43% for 1977-82.

The harvest rate on Babine Lake and River sockeye has been comparable to that of the Pinkut/Fulton/Morrison stock, averaging a few percentage points higher in the early 1970s and a few points lower thereafter. This similarity in harvest rates is quite marked, especially in light of an assumed 2-week difference in the timing of these 'middle' and 'late' stocks. However, the exploitation pattern between fisheries differs noticeably; the late-run Lake and River stock is caught more in Area 3XY and Noyes Island, and less in Area 4, compared to the middle-timing stock. Indeed, the percentage of the catch harvested in Area 4 itself shows some decrease over time, coinciding with poor pink runs and a consequent lower fishing pressure in early August. On the other hand, the fractions of the catch obtained at Noyes Island and in the native food fishery show increasing trends. Timing for the Lake and river stock entering the outermost fisheries peaks in the 3rd week of July, on average, but the peak varies by up to 2 weeks from year to year.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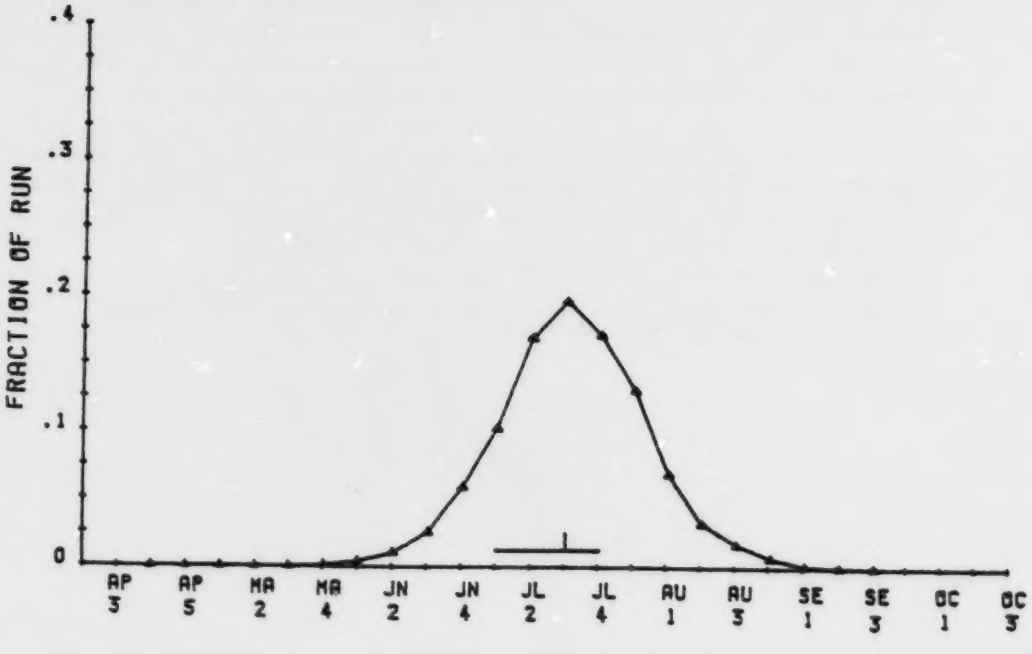
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Area 5 Sockeye

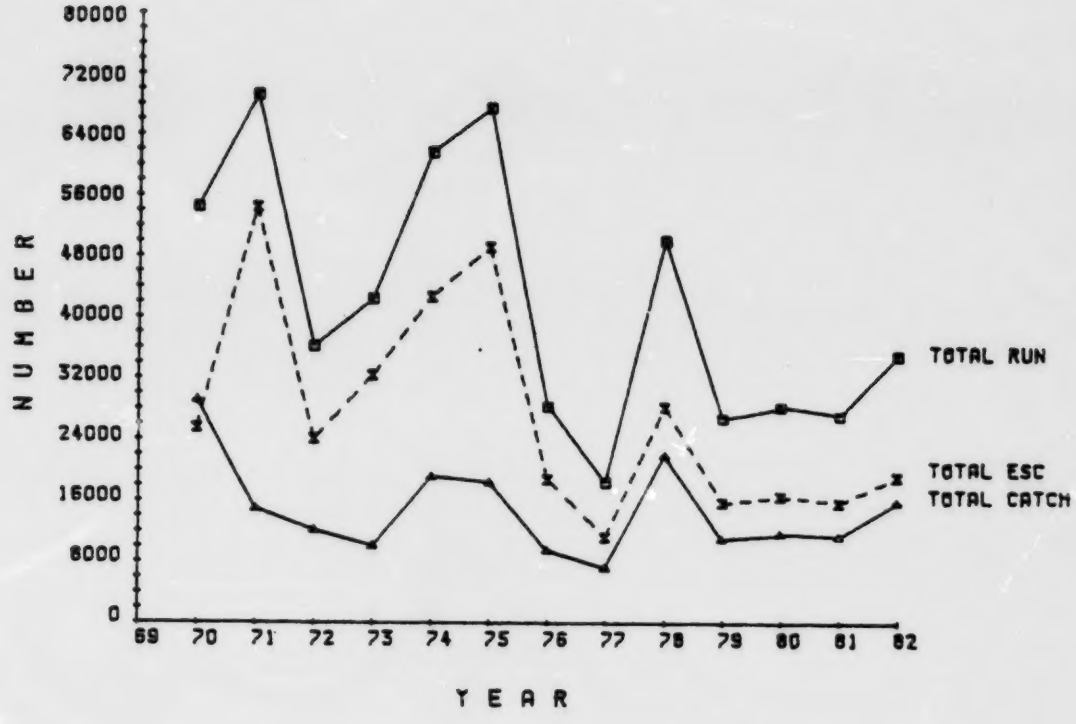
Major components of this stock group include Devon, Bonilla, Curtis and Lowe Inlet stocks, all of which have been fertilized since 1979. Enhanced returns have been poor to date. Migration timing and routes were estimated using historical Indian food fishery information and some limited spawning ground tag recoveries. Escapement estimates are obtained by aerial and foot surveys.

STOCK : AREA 5

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH NATIVE	%CATCH AREA 1	%CATCH AREA 4	%CATCH AREA 5	%CATCH NOYES
1970	55265	29440	25825	53.27	7.13	2.11	19.20	71.50	0.06
1971	70288	15063	55225	21.43	16.60	4.92	29.78	48.70	0.00
1972	36730	12305	24425	33.50	19.10	2.73	29.02	47.82	1.33
1973	43020	10170	32850	23.64	17.12	0.68	72.89	4.56	4.75
1974	62661	19336	43325	30.86	8.65	0.91	71.23	16.32	2.90
1975	68611	18611	50000	27.12	9.40	1.19	65.95	20.94	2.51
1976	28707	9657	19050	33.64	10.35	0.50	36.01	48.30	4.84
1977	18671	7271	11400	38.95	41.12	0.16	38.32	14.34	6.07
1978	50853	22203	28650	43.66	11.26	0.17	42.69	37.07	8.81
1979	27172	11172	16000	41.12	25.06	0.56	33.81	25.00	15.57
1980	28701	11901	16800	41.47	33.61	1.61	28.53	19.15	17.10
1981	27553	11553	16000	41.93	17.31	1.10	44.73	31.79	5.07
1982	35555	16105	19450	45.30	21.73	0.18	35.63	35.20	7.26

Over the period 1970-82, Area 5 run and escapement have averaged 1.8% and 2.8% of the North Coast totals, respectively. The run reconstruction results for Area 5 sockeye stocks point to a consistent decline in escapement and total run over time, together with relatively stable catch levels and an increase in harvest rate on local stocks. It is not clear whether reduced escapements can sustain recent catch levels, or whether a continued decline in Area 5 sockeye is threatened.

The proportions of Area 5 sockeye caught at Noyes Island and in the native food fishery show some increase over time, while the proportions obtained in the Area 4 and Area 5 fisheries show no particular trends. The average timing curve for the entering run of Area 5 sockeye shows a broad peak between the first week of June and the first week of July. The median of the entering run (which splits between Noyes Island and Area 1) occurs the third week of June.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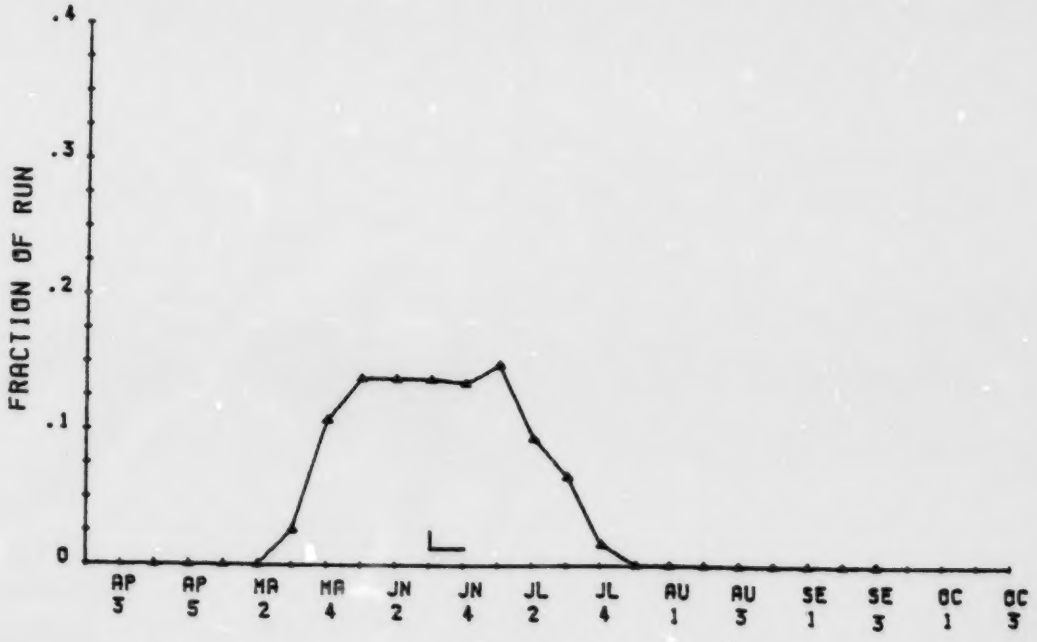
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Central Coast

The Central Coast region, incorporating statistical areas 6 through 10, lies on the western coast of British Columbia between 51° 15' and 53° 15' north latitude. Several sockeye fisheries are identified within the region (Fig. 7). Of these, there is one in each of statistical areas 6, 7, 9 and 10 and three, the Fisher-Fitzhugh, Dean and Bella Coola fisheries, in statistical area 8. Two of these, the Area 7 and Fisher-Fitzhugh fisheries are known to be interception areas. The Area 7 fishery harvest sockeye destined for statistical areas 8 and 9 as well as 7 and the Fisher-Fitzhugh fishery harvests sockeye originating from both areas 8 and 9. The Area 9 and 10 fisheries are target sockeye fisheries while those in statistical areas 6, 7 and 8 take sockeye largely as incidental catch.

Sockeye were caught in the Areas 6, 7 and Fisher-Fitzhugh fisheries with both gillnets and seine nets (Table 9). In all three fisheries the greatest part of the catch was taken in seining operations. The Area 9 fishery also employed both gillnets and seine nets between 1970 and 1978 although the gillnet catch always exceeded that taken by seines. Since 1978 only gillnets have been employed in the Area 9 fishery. Gillnets were the only gear used in the Bella Coola, Dean and Area 10 fisheries. While large troll catches of sockeye were taken in the Central Coast during August, these fish were of South Coast origin and consequently were not included in the Central Coast analyses.

Recent changes in two of the fisheries have affected their impact on Central Coast sockeye stocks. The Laredo Sound portion of the Area 6 fishery is being gradually phased out to conserve early chum runs to the area. Also, the fishing season in statistical area 7, in the vicinity of Milbanke Sound, is being curtailed in an attempt to limit the interception of other salmon species.

Seven major sockeye stocks are identified in Central Coast (Fig. 7). Three of the major stocks are disaggregated into sub-stocks based on timing and routing considerations (Table 10).

Sockeye begin entering Central Coast fisheries in June and peak in abundance in mid to late July. During this period of shoreward migration sockeye move rapidly, not spending more than a week in any one fishery. Following escapement from the last fishery most sockeye move directly into lakes where they remain for approximately two months prior to spawning. Peak spawning activity for Central Coast sockeye occurs in streams and rivers adjacent to the lakes between late September and early October.

Little is known about the variation in run timing for most Central Coast sockeye stocks. The exception however is the Area 10 sockeye stock which is counted through the Docee fence. The fence, first operational in 1968, is located on the Docee River. Area 10 sockeye reach the fence approximately three days after leaving the Area 10 fishery. On average escapement through the fence peaks around July 7 but may be as early as July 1 or as late as July 14.

Between 1970 and 1982 the total run size of Central Coast sockeye stocks ranged from a low of 568,415 fish in 1970 to a high of 3,655,000 fish in 1973 (Fig. 8). The average total run size of Central Coast sockeye between 1970 and 1982, 1,374,667 fish, represents approximately 13% of the total run size of all British Columbia sockeye averaged over the same period.

Central Coast sockeye statistics are clearly dominated by the Area 9 sockeye stock. Since 1970 the average contribution of the Area 9 sockeye stock to the total Central Coast run has approached 60%. Catch statistics since 1953 show a similar pattern with between 50 and 70% of the total Central Coast sockeye catch being taken from Area 9 in most years. However the contribution of the Area 9 stock to the total Central Coast catch has decreased since 1979 as a result of a curtailment in the Area 9 terminal fishery.

Two recent management initiatives are of particular importance with respect to sockeye production on Central Coast. Escapement targets for the stocks in statistical areas 9 and 10 were increased following the 1978 fishing season resulting in a decrease in catch of and harvest rate on these stocks. Also Long Lake, the residence area for juveniles of the Area 10 sockeye stock, has been the subject of a lake enrichment program designed to increase the production of the stock. Long Lake was fertilized in 1976, 1977, 1978, 1981 and 1982. This program is ongoing.

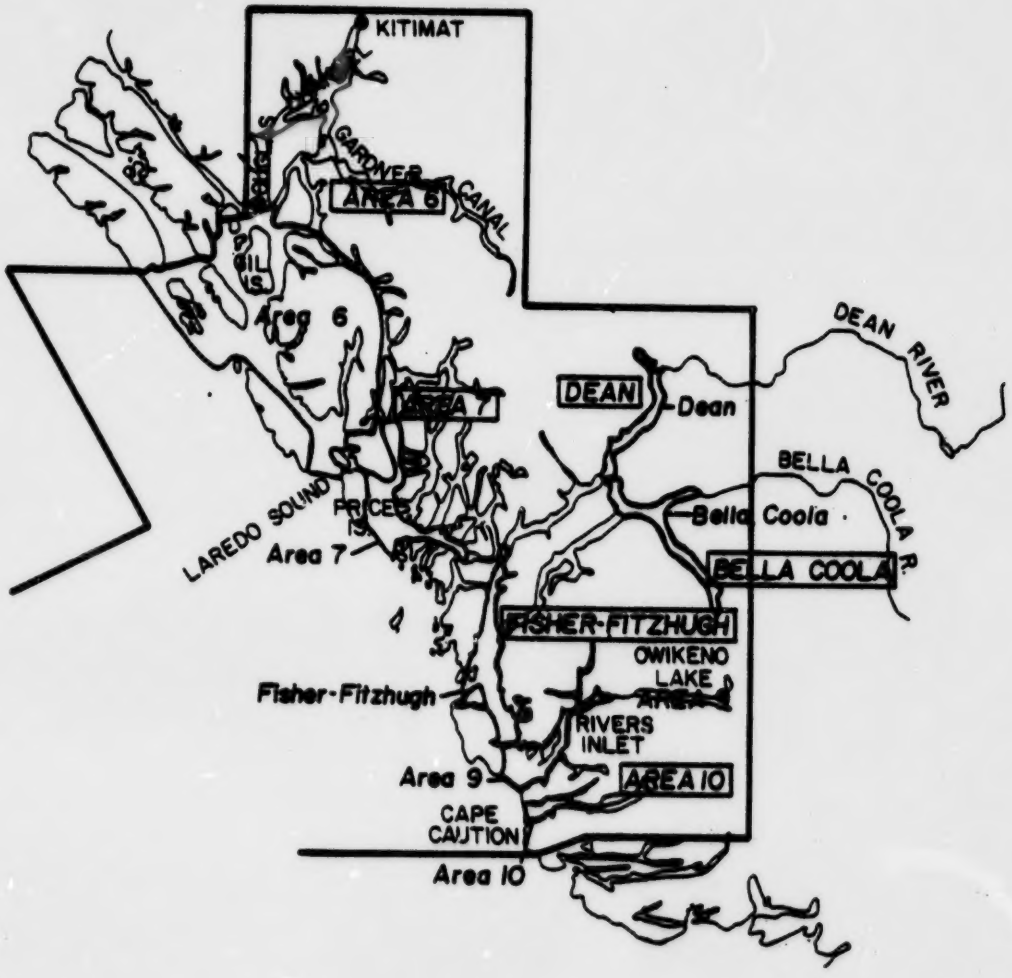


Fig. 7. The major sockeye salmon stocks (boldface type enclosed in boxes) and sockeye salmon fisheries (boldface type not enclosed in boxes) on the Central Coast.

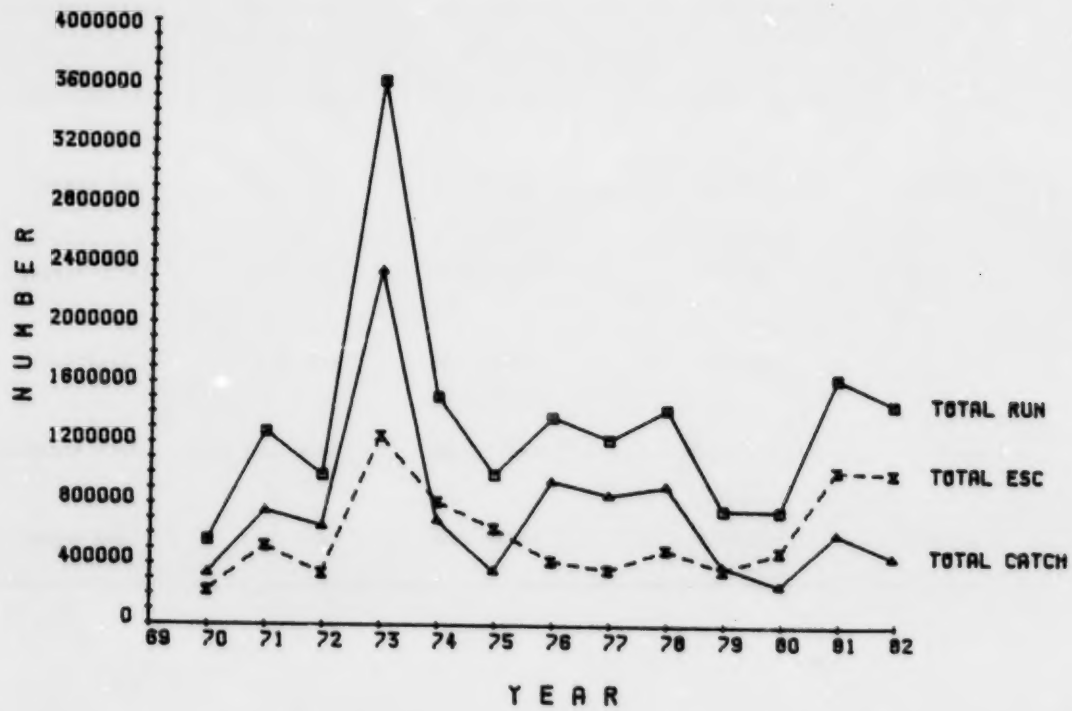


Fig. 8. Catch, escapement and total run size for Central Coast sockeye salmon stocks, 1970 to 1982.

Table 9. Gear types employed in Central Coast sockeye fisheries and catch timing in the fisheries

Fishery	Gear Type(s)	Catch Timing		
		Start	Peak	End
Area 6	gillnet/seine net	early July	late July	early September
Area 7	gillnet/seine net	early July	late July	mid September
Fisher-Fitzhugh	gillnet/seine net	early July	late July	mid August
Bella Coola	gillnet	late June	mid July	early August
Dean	gillnet	early July	mid July	late July
Area 9	gillnet/seine net	early June	late July	late August
Area 10	gillnet	early July	late July	late August

Table 10. Migration routes through fisheries for Central Coast sockeye stocks and subetocks

Stock Name	Sub-stock Name	Routing by Fishery	Proportion of Stock Utilizing each Route
Area 6	none	Area 6	1.00
Area 7	none	Area 7	1.00
Fisher-Fitzhugh	none	Fisher-Fitzhugh	1.00
Bella Coola	Area 7/Bella Coola	Area 7 -> Fisher-Fitzhugh -> Bella Coola	0.50
	Fisher-Fitzhugh/Bella Coola	Fisher Fitzhugh -> Bella Coola	0.50
Dean	Area 7/Dean	Area 7 -> Fisher-Fitzhugh Dean	0.50
	Fisher-Fitzhugh/Dean	Fisher-Fitzhugh -> Dean	0.50
Area 9	Area 9	Area 9	0.80
	Fisher-Fitzhugh/Area 9	Fisher-Fitzhugh -> Area 9	0.15
	Area 7/Area 9	Area 7 -> Area 9	0.05
Area 10	none	Area 10	1.00

Area 6 Sockeye

The Area 6 sockeye stock is intermediate in size with respect to other Central Coast sockeye stocks. Between 1970 and 1982 the total run size of the Area 6 sockeye stock averaged 7.2% of the total run size of all Central Coast stocks. Fish from the Area 6 stock originate from one of 49 streams and rivers, most located in the southern portion of statistical area 6. The Kitlope River has the largest sockeye escapement, averaging 10,000 to 15,000 fish annually, or 20% of the total statistical area 6 sockeye escapement.

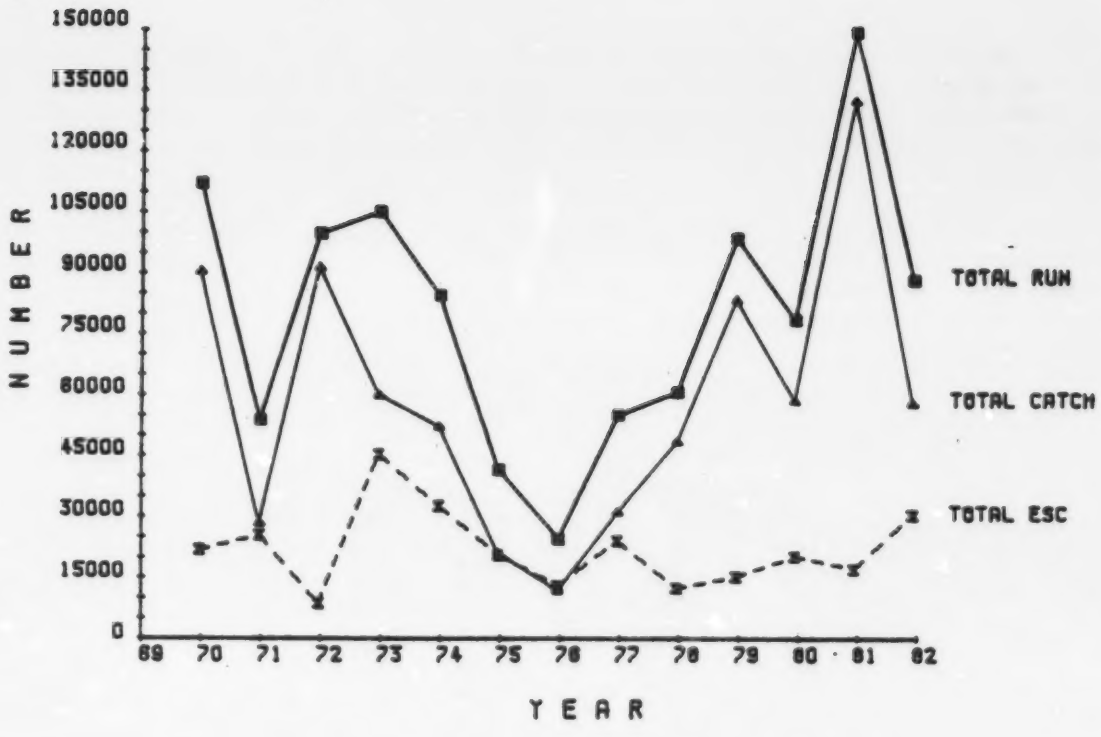
Area 6 sockeye approach their natal streams from a westardly direction and are not known to be taken by fisheries outside statistical area 6. The Area 6 fishery does not target on Area 6 sockeye but rather takes them as incidental catch.

STOCK : AREA 6

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE
1970	111229	89577	21652	80.53
1971	53311	28061	25250	52.64
1972	98879	90355	8524	91.38
1973	104006	59204	44802	56.92
1974	83754	51504	32250	61.49
1975	41179	20865	20314	50.67
1976	24277	11473	12804	47.26
1977	54569	30795	23774	56.43
1978	60172	47902	12270	79.61
1979	97766	82690	15076	84.58
1980	77965	57971	19994	74.36
1981	148421	131503	16918	88.60
1982	87610	57410	30200	65.53

Total run size and catch of the Area 6 sockeye stock decreased between 1970 and 1976. Following the 1976 fishing season both run size and catch increased reaching a maximum in 1981. There has been no trend towards increasing or decreasing escapement over the 1970 to 1982 period. Harvest rates over the same period have averaged 68%.

The Area 6 sockeye stock first enters the vicinity of the Area 6 fishery in mid-June. Abundance in the fishery peaks in mid to late July and by mid-August most Area 6 sockeye have passed through the fishery.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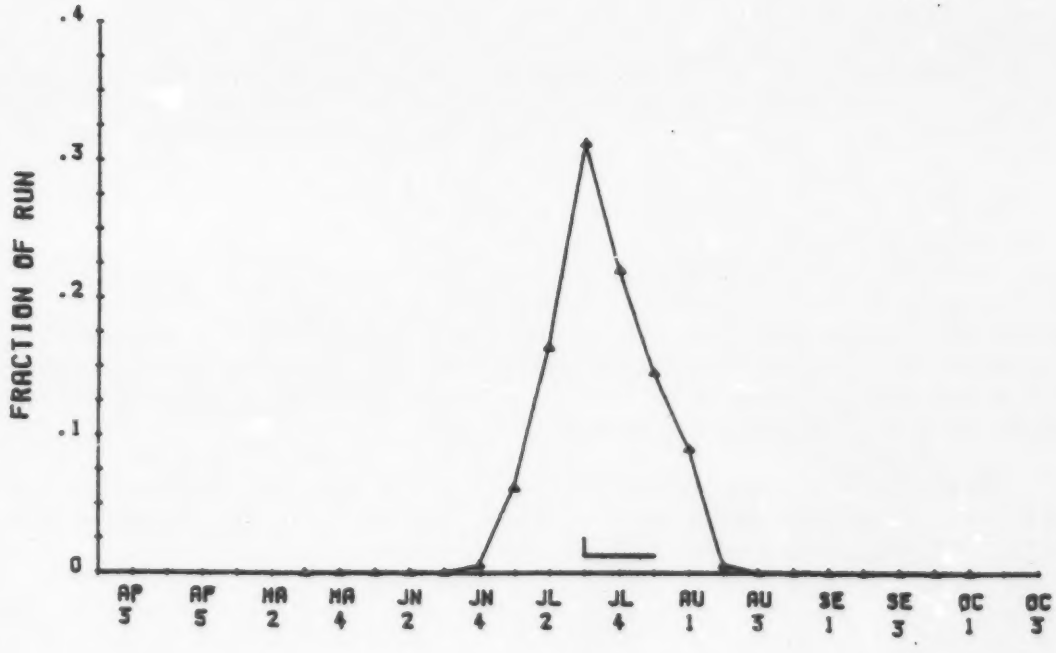
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Area 7 Sockeye

The Area 7 sockeye stock is small and composed of fish originating from approximately 20 streams. None of the streams are major sockeye production systems and only two, Kakushdish and Tankeeah Creeks, consistently have escapements in excess of 1000 fish. All escapement estimates are made by foot surveys.

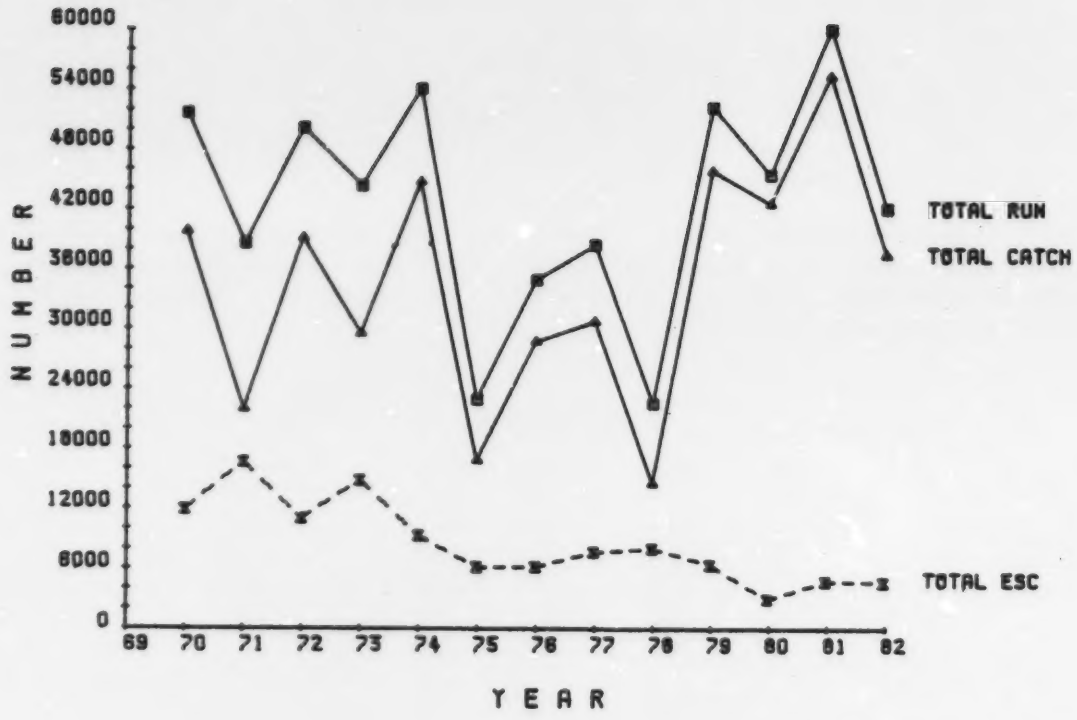
Area 7 sockeye generally approach their natal streams from a westerly direction and are not known to be intercepted by any fishery outside statistical area 7. The stock is not the primary target of any fishery but rather individuals from the stock are taken as incidental catch in the Area 7 chum and pink fishery.

STOCK : AREA 7

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE
1970	51271	39472	11799	76.99
1971	38279	21781	16498	56.90
1972	49699	38794	10905	78.06
1973	43980	29284	14696	66.58
1974	53553	44334	9219	82.79
1975	22711	16663	6048	73.37
1976	34642	28517	6125	82.32
1977	38078	30502	7576	80.10
1978	22323	14396	7927	64.49
1979	51788	45507	6281	87.87
1980	45114	42193	2921	93.53
1981	59564	54901	4663	92.17
1982	41779	37177	4602	88.98

There has been no consistent trend in the total run size or catch of the Area 7 sockeye stock between 1970 and 1982. Total run size and catch did however decrease dramatically following the 1974 fishing season and they did not return to levels found in the earlier 1970's until 1979. Estimates of escapement have declined almost continuously since 1973. In recent years, 1980 to 1982, escapement estimates were approximately 60% less than those for the 1970 to 1973 period. Harvest rates on the Area 7 sockeye stock have been high throughout the period of study, particularly between 1974 and 1982, a time which corresponds to the period of decreasing escapements. The observations that escapements have declined since 1974 while catch and total run sizes have increased and harvest rates have been high suggests that some proportion of the catch allocated to the Area 7 sockeye stock may actually have originated from other Central Coast sockeye stocks.

The Area 7 sockeye stock first enters the vicinity of the Area 7 fishery in mid-May. Abundance peaks in the fishery in mid-July and by early October most Area 7 sockeye have passed through the fishery.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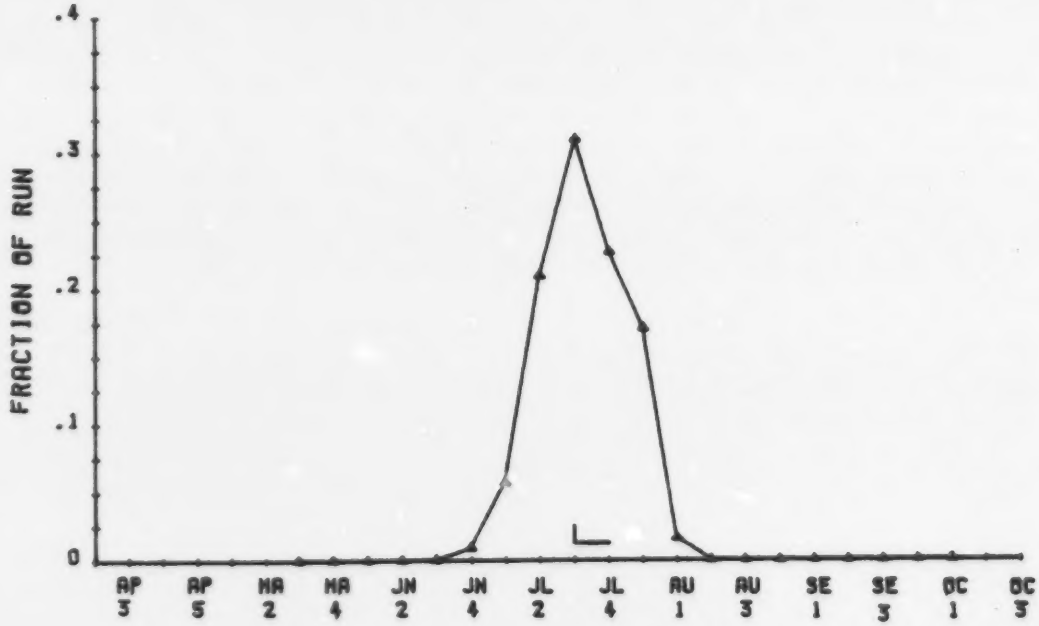
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Fisher-Fitzhugh Sockeye

In most years between 1970 and 1982 the total run size of the Fisher-Fitzhugh sockeye stock was small. Over this period the total run size of the Fisher-Fitzhugh stock averaged 3.9% of the total run size for all Central Coast sockeye stocks. The Fisher-Fitzhugh sockeye stock originates from nine streams and rivers entering Fisher Channel and Fitzhugh Sound in the western portion of statistical area 8. Two of these rivers, the Namu and the Koeye, account for over 80% of the escapement of the Fisher-Fitzhugh stock. All escapement estimates are made by foot surveys.

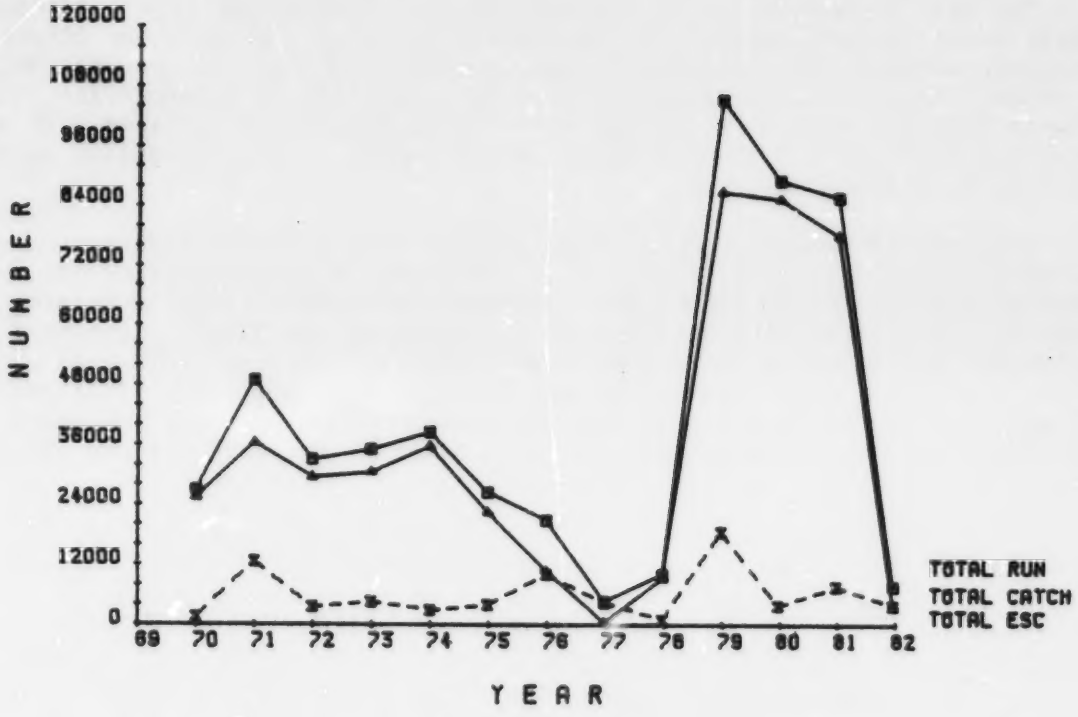
Fisher-Fitzhugh sockeye generally approach their natal streams from a westerly direction and are not known to be intercepted by fisheries outside the Fisher-Fitzhugh area. The stock is not the primary target of the Fisher-Fitzhugh fishery.

STOCK : FISHER-FITZHUGH

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE
1970	26775	25273	1502	94.39
1971	48608	36098	12510	74.26
1972	32852	29350	3502	89.34
1973	34816	30312	4504	87.06
1974	38235	35431	2804	92.67
1975	26226	22323	3903	85.12
1976	20760	10703	10057	51.56
1977	4689	436	4253	9.30
1978	10050	9100	950	90.55
1979	104369	85956	18413	82.36
1980	88165	84459	3706	95.80
1981	84778	77218	7560	91.08
1982	7617	3911	3706	51.35

Total run size and catch of the Fisher-Fitzhugh stock decreased from the early 1970's to 1977 when the total run size and catch were 4,689 and 436 fish respectively. Following the 1977 fishing season both total run size and catch increased dramatically and remained at high levels through 1981 before collapsing again in 1982. Estimates of escapement while varying by a factor of 12 between 1970 and 1982, showed no consistent trend towards increasing or decreasing. Harvest rates on the Fisher-Fitzhugh sockeye stock fluctuated widely from in excess of 90% to less than 10%.

The Fisher-Fitzhugh sockeye stock first enters the vicinity of the fishery in mid-May. Abundance peaks in the fishery in late July and by early October most Fisher-Fitzhugh sockeye have passed through the fishery.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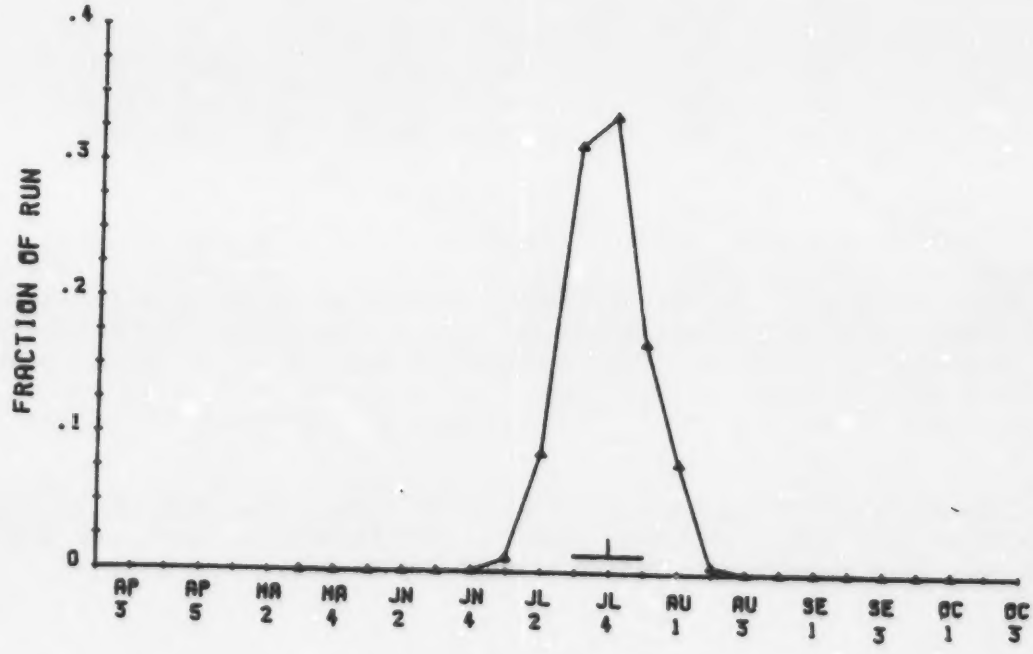
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Dean Sockeye

The Dean sockeye stock is composed of fish originating from 4 streams and rivers entering Dean Channel in statistical area 8. One of these rivers, the Kimsquit, accounts for over 95% of the escapement of the Dean stock. Relative to other Central Coast sockeye stocks, the Dean stock is intermediate in size. Between 1970 and 1982 the total run size of the Dean stock averaged 3.7% of the total run size for all Central Coast sockeye stocks. All escapement estimates are made by foot surveys.

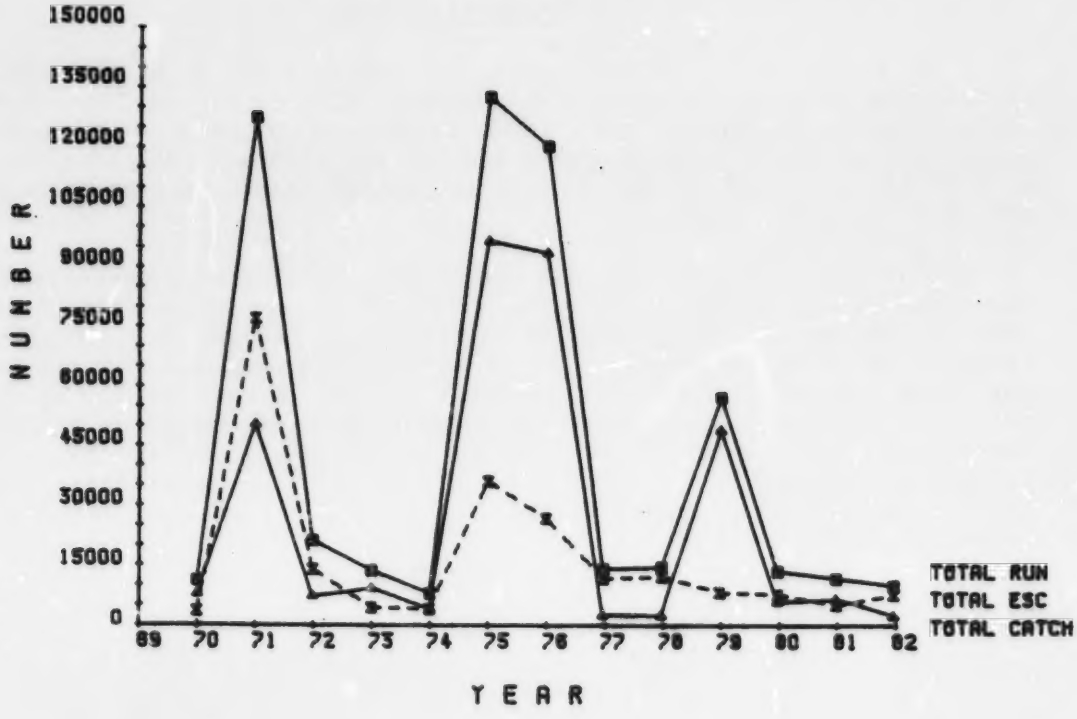
Dean sockeye approach their natal streams from a westerly direction as two discrete sub-stocks. The Area 7/Dean sub-stock moves first into the Area 7 fishery, through the Fisher-Fitzhugh fishery and finally into the terminal Dean fishery. The Fisher-Fitzhugh/Dean sub-stock enters the Fisher-Fitzhugh fishery initially before moving into the Dean fishery. Between 1970 and 1982 the proportion of the catch of Dean sockeye stock taken by the Dean, Fisher-Fitzhugh and Area 7 fisheries was 67, 23 and 10% respectively. In only two years, 1972 and 1978, did the proportion of the catch taken by the Dean fishery fall below 50%.

STOCK : DEAN

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH AREA 7	%CATCH FISHER-FITZHUGH	%CATCH DEAN
1970	11162	7662	3500	68.64	9.82	19.51	70.68
1971	126379	49883	76496	39.47	0.00	5.81	94.19
1972	21109	7185	13924	34.04	28.13	43.34	28.53
1973	13522	9198	4324	68.02	0.12	5.38	94.50
1974	7954	4030	3924	50.67	10.14	16.81	73.06
1975	131280	95528	35752	72.77	5.91	13.29	80.80
1976	119047	92519	26528	77.72	5.76	11.49	82.75
1977	13976	2432	11544	17.40	44.09	5.37	50.53
1978	14465	2413	12052	16.68	22.99	61.93	15.09
1979	56573	48445	8128	85.63	3.98	19.20	76.83
1980	13324	5728	7596	42.99	0.04	38.91	61.05
1981	11572	6572	5000	56.79	2.11	42.81	55.08
1982	9719	2219	7500	22.83	0.01	11.02	88.96

The Dean sockeye stock exhibited a pronounced four year cycle in total run size and catch. Cycle maxima occurred in 1971, 1975 and 1979. In 1971 and 1975 the total run was in excess of 125,000 sockeye while in 1979 it decreased to approximately 60,000. Total run minima were approximately 13,000. Estimates of escapement have declined with escapement in the 1979 cycle peak being approximately an order of magnitude lower than the 1971 cycle peak. Harvest rates, under 70% in most years, have averaged approximately 50% between 1970 and 1982.

The Area 7/Dean sub-sockeye stock first enters the vicinity of the Area 7 fishery in late May. Abundance peaks in the fishery in late June and by late July most Dean sockeye have passed through the fishery.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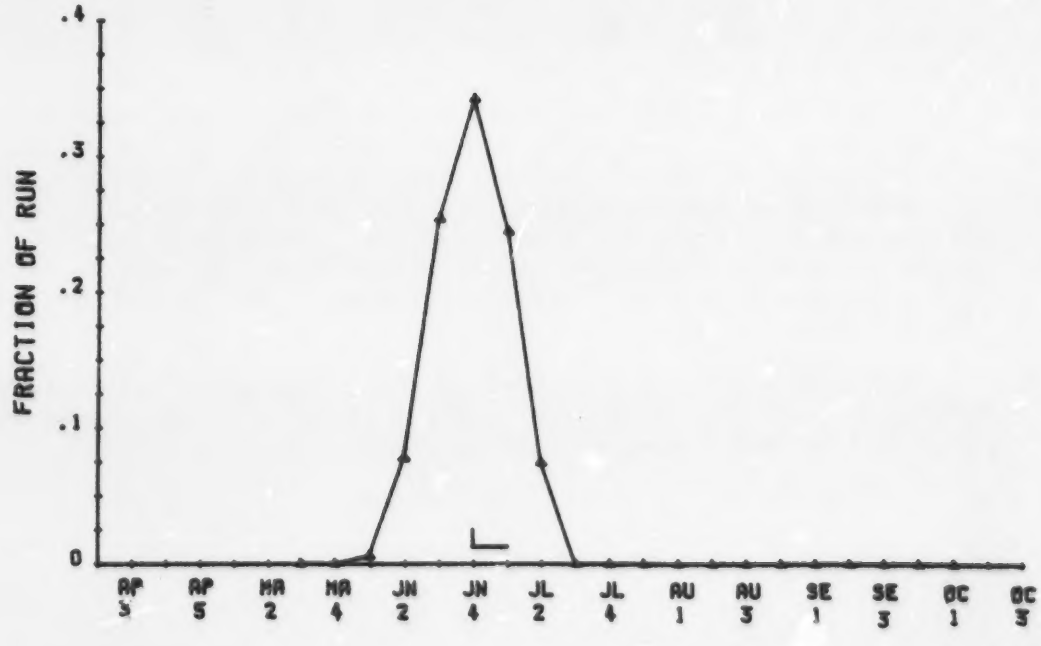
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Bella Coola Sockeye

The Bella Coola sockeye stock is composed of a single group of fish originating from the Atnarko River between Stillwater and Tenas Lake, east of Bella Coola. The Bella Coola stock is moderately large with respect to most other Central Coast sockeye stocks and between 1970 and 1982 composed on average 6.7% of the total run of all sockeye to Central Coast. All escapement estimates are based on tower counts.

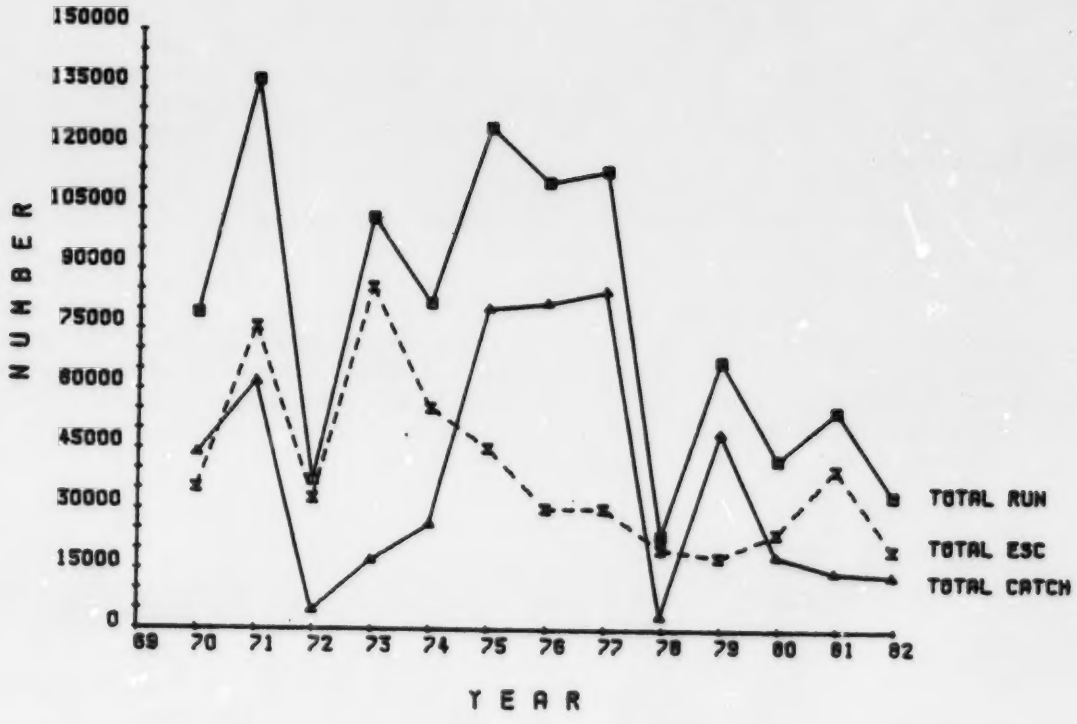
Bella Coola sockeye approach the Atnarko River from a westerly direction as two discrete sub-stocks. The Area 7/Bella Coola sub-stock moves first into the Area 7 fishery, through the Fisher-Fitzhugh fishery and finally into the terminal Bella Coola fishery. The Fisher-Fitzhugh/Bella Coola sub-stock enters the Fisher-Fitzhugh fishery initially before moving into the Bella Coola fishery. The proportion of the catch taken in the terminal Bella Coola fishery fluctuated widely from 0% in 1978 to greater than 99% in 1971. On average between 1970 and 1982 the proportion of the catch of Bella Coola sockeye taken by the Bella Coola, Fisher-Fitzhugh and Area 7 fisheries was 67, 25 and 8% respectively.

STOCK : BELLA COOLA

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH AREA 7	%CATCH FISHER-FITZHUGH	%CATCH BELLA COOLA
1970	78521	43521	35000	55.43	26.34	52.36	21.29
1971	136330	61330	75000	44.99	0.00	0.15	99.85
1972	37112	4608	32504	12.42	31.81	46.14	22.05
1973	102118	17118	85000	16.76	0.09	13.43	86.48
1974	81067	26063	55004	32.15	10.31	19.28	70.41
1975	124632	79632	45000	63.89	1.80	4.56	93.64
1976	111166	81066	30100	72.92	3.73	7.70	88.57
1977	114053	84005	30048	73.65	0.84	1.55	97.61
1978	23397	3345	20052	14.30	27.55	72.45	0.00
1979	66782	48726	18056	72.96	11.93	34.10	53.97
1980	42264	18264	24000	43.21	0.02	19.19	80.79
1981	54348	14340	40008	26.39	1.30	32.93	65.77
1982	33478	13458	20020	40.20	0.01	4.73	95.27

Unlike the adjacent Dean sockeye stock, Bella Coola sockeye did not exhibit a clear four year cycle although total run sizes and catches were greater in 1971, 1975 and 1979 than in the immediate preceding or following years. Between 1970 and 1982 the total run size of Bella Coola sockeye declined although there was no apparent long-term trend in catch. Escapement estimates have declined almost continuously since the early 1970's when they were as great as 850,000 fish. Harvest rates have fluctuated between 10 and 75% and averaged 45% between 1970 and 1982.

The Area 7/Bella Coola sub-stock first enters the vicinity of the Area 7 fishery in late May. Abundance peaks in late June and by late July most Bella Coola sockeye have passed through the fishery.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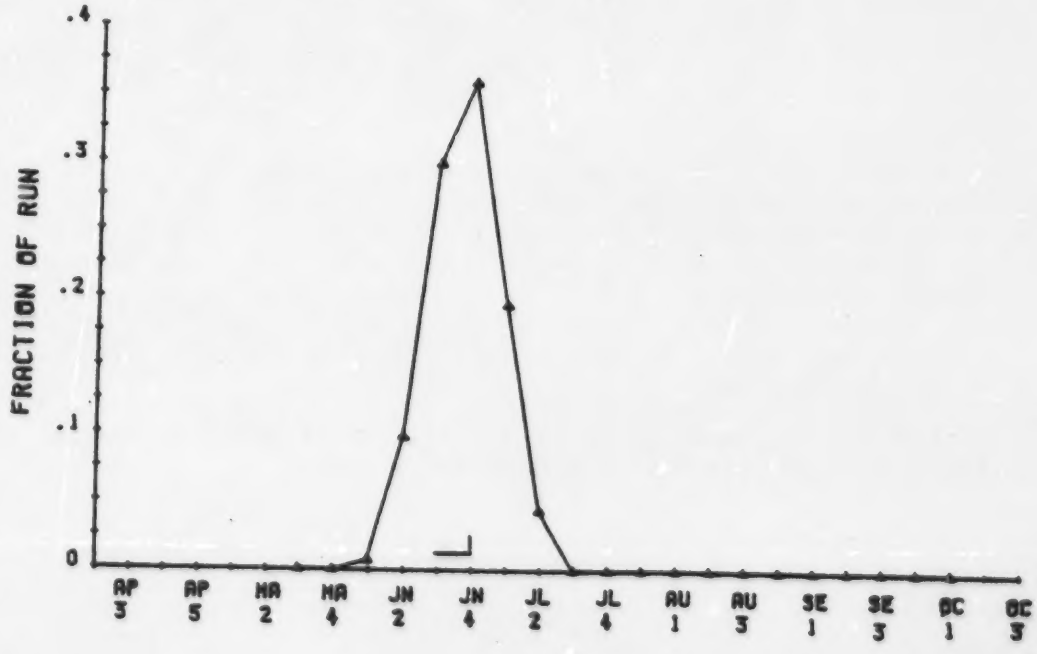
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Area 9 Sockeye

The Area 9 sockeye stock is the largest sockeye stock on Central Coast. Between 1970 and 1982 the total run size of the Area 9 stock averaged 57% of the total run size of all Central Coast sockeye stocks. The stock originates from a complex of 14 streams and rivers in statistical area 9. At least eight of these are major sockeye production systems and flow into Owikeno Lake where the juvenile sockeye reside before migrating to sea. Escapement of returning adults is estimated in the eastern most portion of Rivers Inlet using hydroacoustic techniques.

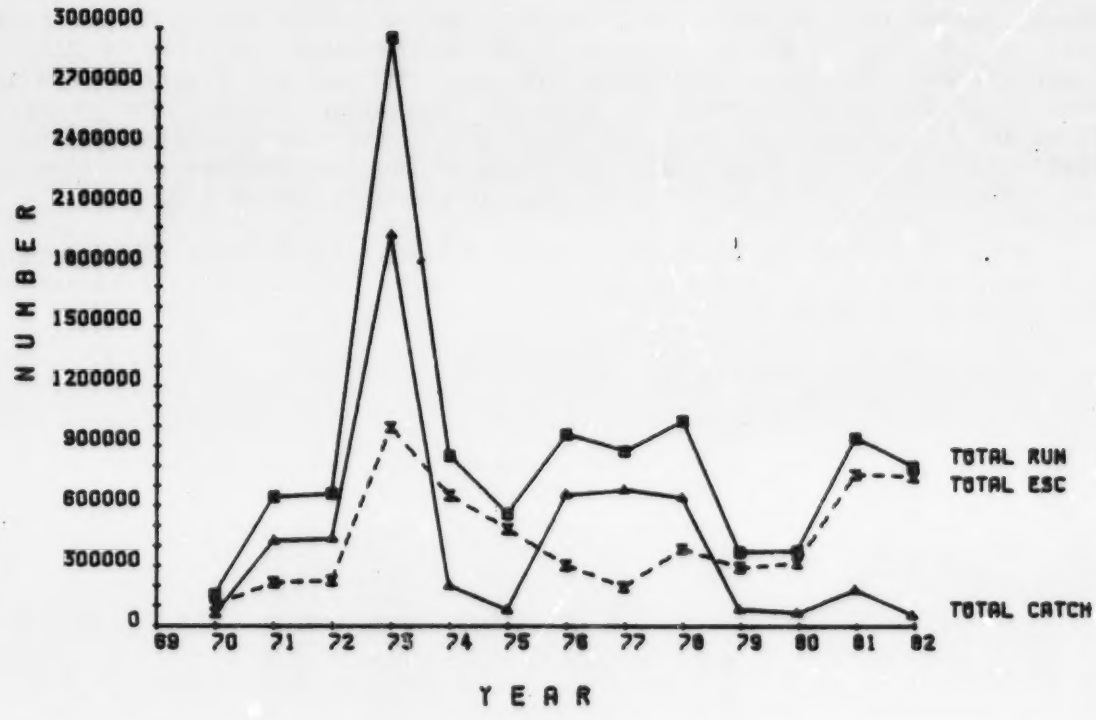
Area 9 sockeye approach their natal streams as three discrete sub-stocks. The Area 7/Area 9 sub-stock initially enters the Area 7 fishery, and then moves into the terminal Area 9 fishery. The Fisher-Fitzhugh/Area 9 sub-stock moves through the vicinity of the Fisher-Fitzhugh fishery before arriving at Area 9 fishery. Finally, the Area 9 sub-stock moves directly into the Area 9 fishery. Prior to 1979 most of the catch from the Area 9 sockeye stock was taken in the Area 9 fishery. However, in recent years the proportion of the total catch taken in the Area 9 fishery has decreased due in part to attempts to increase escapement out of the terminal Area 9 fishery.

STOCK : AREA 9

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE	%CATCH AREA 7	%CATCH FISHER-FITZHUGH	%CATCH AREA 9
1970	157667	55418	102250	35.15	5.23	60.88	33.89
1971	639468	423569	215899	66.24	0.92	4.41	94.67
1972	656776	432275	224501	65.82	29.03	9.64	87.46
1973	2928935	1943933	985002	66.37	0.07	8.32	91.61
1974	844525	197497	647028	23.39	7.96	31.71	60.33
1975	556726	76724	480002	13.78	8.59	42.15	49.26
1976	949754	649752	300002	68.41	2.52	2.82	94.66
1977	865497	673901	191596	77.86	1.18	0.25	98.57
1978	1017013	634009	383004	62.34	1.47	6.27	92.26
1979	368748	78726	290022	21.35	8.39	55.42	36.19
1980	375310	62312	312998	16.60	7.28	91.44	1.28
1981	932621	179550	753071	19.25	12.88	31.99	55.14
1982	793350	51350	742000	6.47	10.25	14.00	75.75

Total run size of the Area 9 sockeye stock has shown no consistent trend towards increasing or decreasing between 1970 and 1982. The largest estimated run size, approximately 3 million fish in 1973, was three times greater than for any other year. As well, there was no trend in catch between 1970 and 1978. However, following the 1978 fishing season the catch of Area 9 sockeye has been low due largely to the increase in escapement targets described above. The average harvest rate of Area 9 sockeye between 1970 and 1982 was 42%.

The Area 9 sockeye stock first enter the vicinity of the Area 7 fishery in late May. Abundance peaks in the fishery in mid-July and by mid-August most Area 9 sockeye have passed through the fishery.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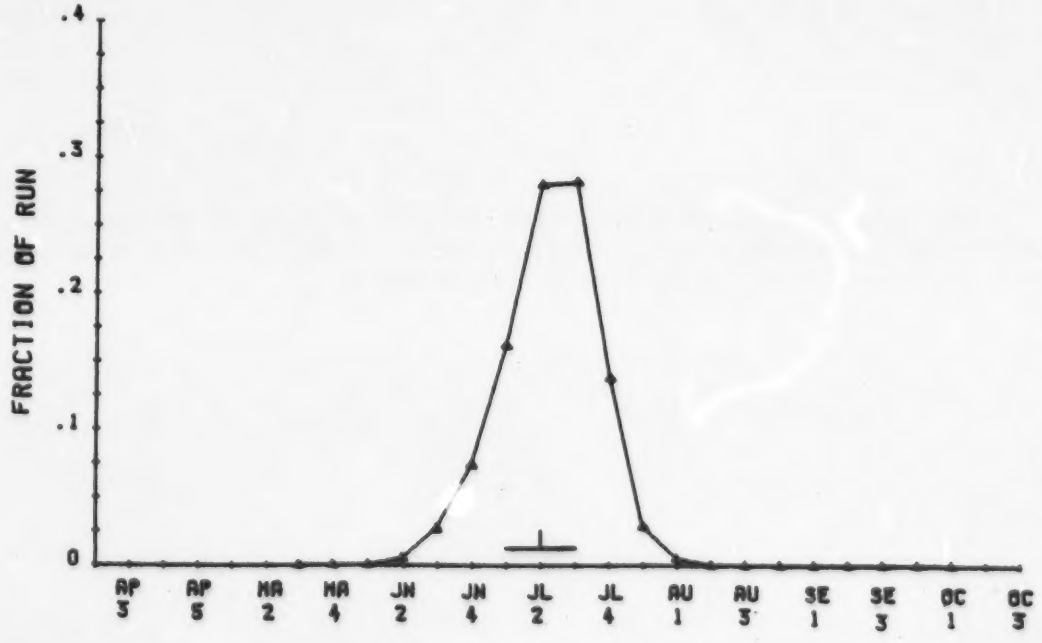
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Area 10 Sockeye

The Area 10 sockeye stock is one of the largest sockeye stocks on Central Coast, second only to the Area 9 stock. Between 1970 and 1982 the total run size of the Area 10 stock averaged 17.3% of the total run size of all Central Coast stocks. The stock originates from four streams and rivers in statistical area 10. The major sockeye producer is Smokehouse Creek. The creek, which flows into Long Lake, accounts for 75 to 80% of the annual sockeye escapement to statistical area 10. Escapements to three of the four sockeye producing systems are estimated at the Docee fence located at the west end of Long Lake.

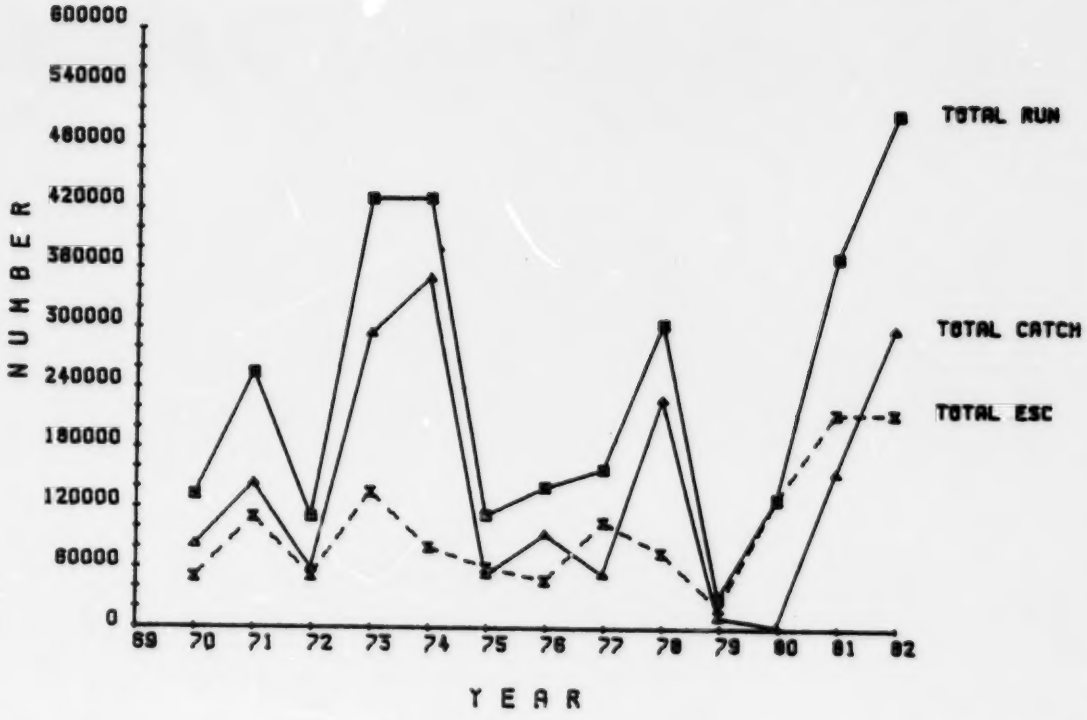
Area 10 sockeye approach their natal streams from a westardly direction and are only caught in the terminal Area 10 fishery. The stock is a target species for the Area 10 fishery.

STOCK : AREA 10

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE
1970	131789	81789	50000	62.06
1971	253530	143532	109998	56.61
1972	110487	58987	51500	53.39
1973	427823	292825	134998	68.45
1974	427731	347731	80000	81.30
1975	112450	52452	59998	46.64
1976	139896	92894	47002	66.40
1977	158046	53044	105002	33.56
1978	302127	227129	74998	75.18
1979	31317	10293	21024	32.87
1980	130121	2119	128002	1.63
1981	368489	154489	214000	41.92
1982	511264	297264	214000	58.14

Total run size and catch of the Area 10 sockeye stock fluctuated widely between 1970 and 1982 but there was no apparent trend toward increasing or decreasing stock size. There was no trend in escapement estimates between 1970 and 1978, however in recent years escapement estimates are well above the historical average. The average harvest rate of Area 10 sockeye between 1970 and 1982 was 52%.

The Area 10 sockeye stock first enter the vicinity of the Area 10 fishery in late May. Abundance in the fishery peaks in mid-July and by mid-August most Area 10 sockeye have passed through the fishery.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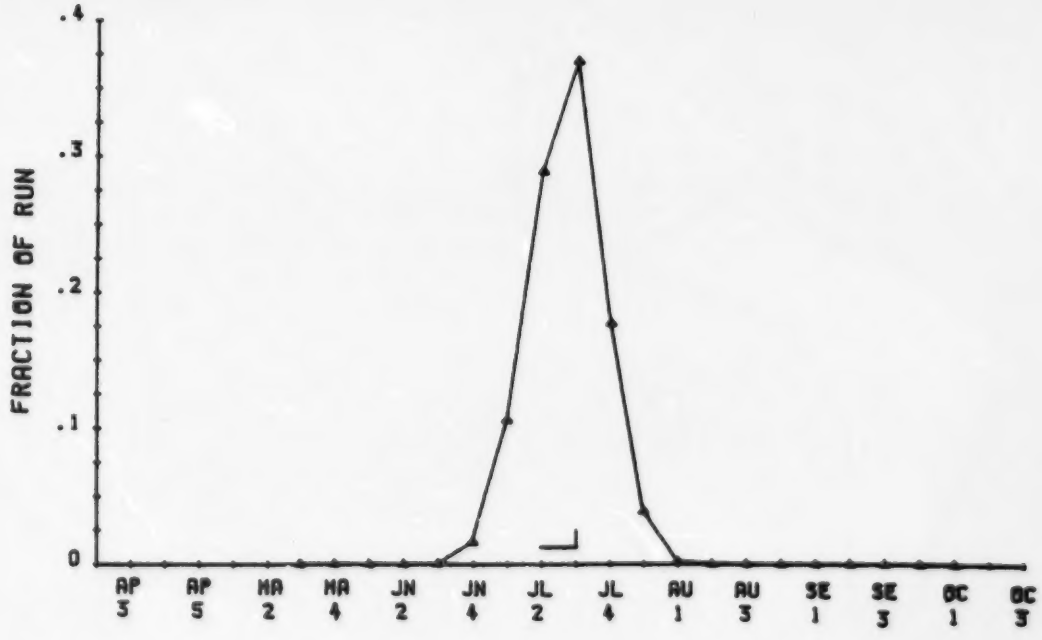
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West Coast

The West Coast region, incorporating statistical areas 21 through 27, lies on the west coast of Vancouver Island between 48° 20' and 51° 50' north latitude (Fig. 9). Each year large numbers of sockeye are caught in the region however only a small proportion of the fish originate from the West Coast. Most of the catch consists of sockeye migrating to the Fraser River and adjacent locales along the southern mainland of British Columbia and the coasts of Washington and Oregon. Only sockeye stocks in statistical area 23 are large and productive enough to sustain a commercial fishery (Fig. 10).

Three sockeye stocks have been identified in statistical area 23. The Great Central and Sproat Lake stocks are the largest and together accounted for approximately 93% of the total sockeye run to statistical area 23 between 1970 and 1982. The much smaller Henderson Lake stock accounted for 7% over the same period. All three stocks approach statistical area 23 from a westwardly direction and, with the possible exception of the Henderson Lake stock, are not subjected to fisheries west of Barkley Sound. Great Central and Sproat Lake stocks begin entering the vicinity of the statistical area 23 fishery in mid-May and peak in late June to early July. The Henderson stock follows the Great Central and Sproat stocks by several weeks.

The fishery on statistical area 23 sockeye stock extends west from Alberni Canal to the outer areas of Barkley Sound. Prior to 1982 gillnet and seine net operators were common throughout the entire area. Beginning in 1982 however the gears were geographically separated, seine nets being restricted to Alberni Canal and gillnets occupying the more westerly areas. The separation of gear has reduced the incidental seine catch of young springs in the western portion of the sound and has also permitted the exploitation of sockeye occupying the deep water areas of Alberni Canal. In addition, the body of water immediately southeast of Henderson River was closed to fishing after mid-July in 1982 in an attempt to conserve the later returning Henderson sockeye stock. There have been many changes in the exact location of the fishing boundaries in statistical area 23 since 1970. There has also been a dramatic increase in fishing effort. Between 1973 and 1981 the number of gillnet and seine net boat days has increased by approximately three and 33 times respectively.

Fig. 9. The major sockeye salmon stocks (boldface type enclosed in boxes) and sockeye salmon fisheries (boldface type not enclosed in boxes) on the West Coast.

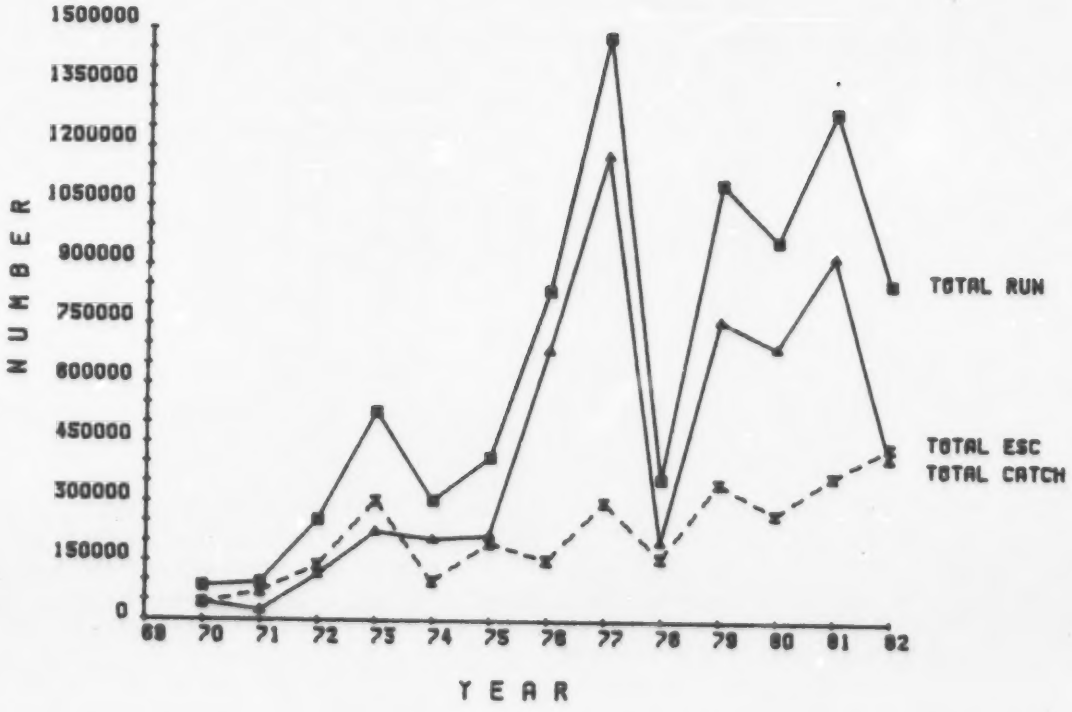


Fig. 10. Catch, escapement and total run size for West Coast sockeye salmon stocks, 1970 to 1982.

Great Central Lake Sockeye

In most years between 1970 and 1982 the total run size of the Great Central Lake sockeye stock was the largest of all sockeye stocks on the west coast of Vancouver Island. Over this period the total run size of the Great Central Lake stock averaged 59% of the total run size of all sockeye stocks in statistical area 23. The Great Central Lake sockeye stock originates from Great Central Lake where the adults spawn and the juveniles reside prior to migrating to sea. Between 1976 and 1982 escapement estimates were made with an electronic counter placed on the Stamp River. Between 1970 and 1974 the estimates were made using fishway counts. In 1975 a combination of fishway and electronic counts were employed.

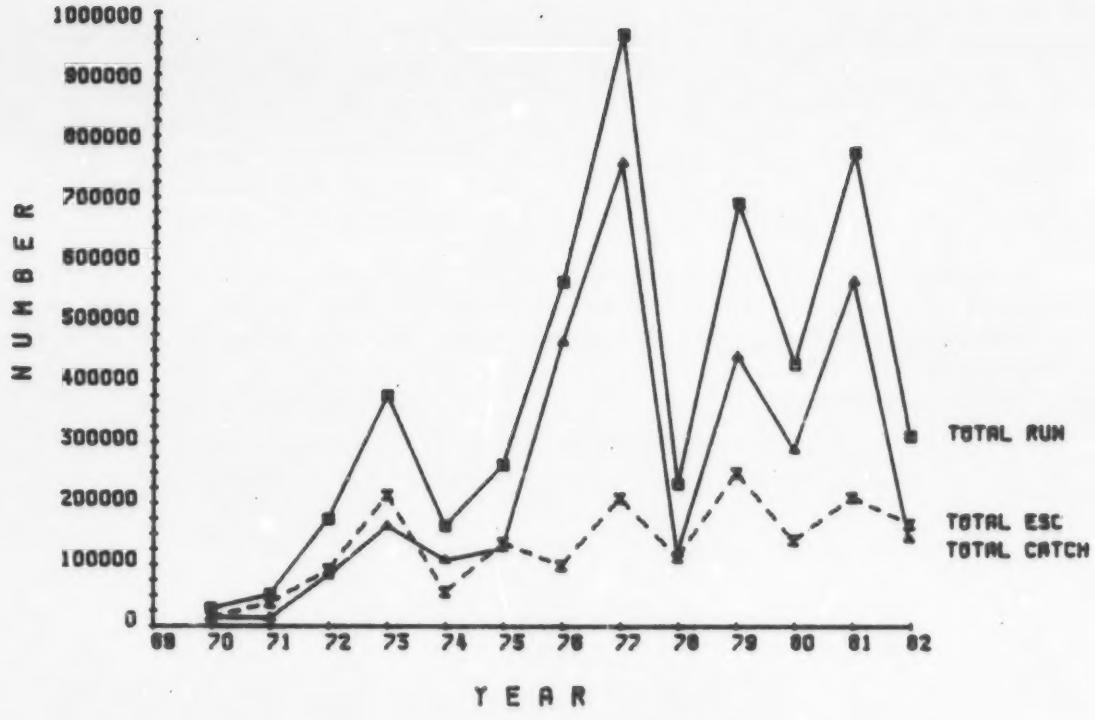
Great Central Lake sockeye approach their natal area from a westardly direction and are not intercepted by fisheries outside Area 23 (ie. Barkley Sound). The Great Central Lake stock together with the Sproat stock are the primary targets of the Area 23 sockeye fishery.

STOCK : GREAT CENTRAL LAKE

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE
1970	29737	14582	15155	49.04
1971	52822	13610	39212	25.77
1972	177016	83723	93293	47.30
1973	381566	165390	216176	43.35
1974	166160	109793	56367	66.08
1975	267614	129499	138115	48.39
1976	571428	470815	100613	82.39
1977	980204	768038	212166	78.35
1978	235741	121301	114440	51.46
1979	701367	447371	253996	63.79
1980	434278	291887	142391	67.21
1981	785061	571721	213340	72.83
1982	314979	145594	169385	46.22

The total run size and catch of the Great Central Lake sockeye stock has increased in a discontinuous fashion since 1970. The largest total run and catch occurred in 1977 at 980,000 and 768,000 pieces respectively. Estimates of escapement have also increased since 1970 and in recent years have averaged close to 200,000 fish. Annual harvest rates have shown little variation and have averaged 55% between 1970 and 1982.

The Great Central Lake sockeye stock first enters Barkley Sound in early May. Abundance in the fishery peaks in early July and by mid-September most Great Central Lake sockeye have passed through the fishery. In most years between 1970 and 1982 the timing of Great Central Lake sockeye through the fishery has exhibited some degree of bimodality with the early July abundance peak being followed by a second smaller peak in mid-August.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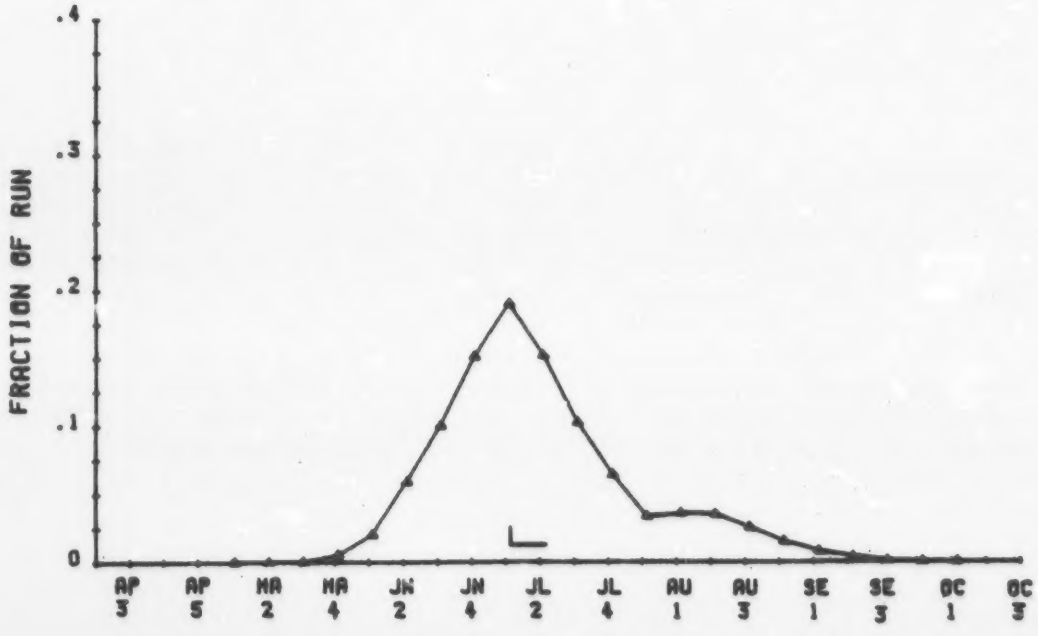
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Sproat Lake Sockeye

In most years between 1970 and 1982 the total run size of the Sproat Lake sockeye stock was intermediate between the other two statistical area 23 sockeye stocks. Over this period the total run size of the Sproat Lake stock averaged 34% of the total run size of all sockeye stocks to statistical area 23. The Sproat Lake stock originates from Sproat Lake where adults spawn and juveniles reside prior to migrating to sea. Between 1976 and 1982 the escapement estimates were made with an electronic counter located on Sproat River. Between 1970 and 1974 the estimates were made using fishway counts. In 1975 a combination of fishway and electronic counts were employed.

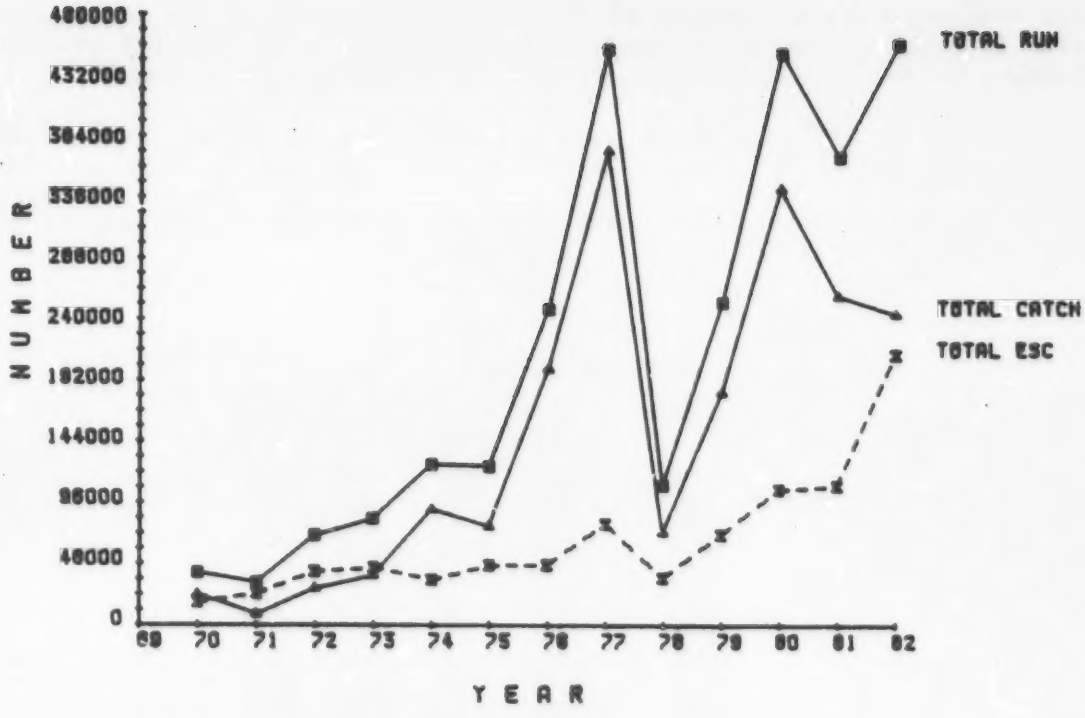
Sproat Lake sockeye approach their natal area from a westardly direction and are not intercepted by fisheries outside Area 23 (ie. Barkley Sound). The Sproat stock together with the Stamp stock are the primary targets of the Area 23 sockeye fishery.

STOCK : SPROAT LAKE

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE
1970	41646	23692	17954	56.89
1971	33708	8665	25043	25.71
1972	71537	28930	42607	40.44
1973	84921	39337	45658	46.32
1974	127604	91846	35842	71.98
1975	125971	78617	47522	62.41
1976	251314	203610	47709	81.02
1977	458453	377703	80793	82.39
1978	111252	73734	37538	66.28
1979	256968	184704	72266	71.88
1980	455678	347657	108021	76.29
1981	373026	262010	111016	70.24
1982	462981	247646	215445	53.49

The total run size and catch of Sproat Lake sockeye has increased in discontinuous fashion since 1970. The largest total run sizes, occurring in 1977, 1980 and 1982, were approximately an order of magnitude greater than the runs of the early 1970's. Estimates of escapement have also increased, most rapidly since 1978. Annual harvest rates have averaged 60% between 1970 and 1982.

The Sproat sockeye stock first enters Barkley Sound in early May. Abundance peaks in the fishery in early July and by early September most Sproat Lake sockeye have passed through the fishery. Unlike the Great Central Lake stock, Sproat sockeye show no bimodality in their run timing.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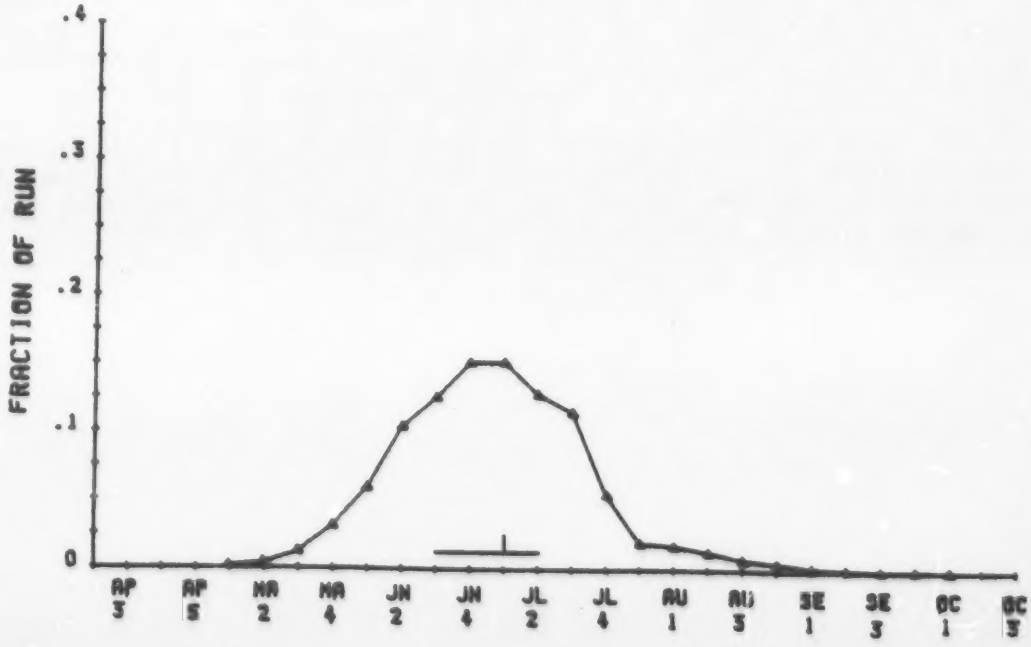
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Henderson Lake Sockeye

The Henderson Lake sockeye stock is the smallest of the three stocks identified in statistical area 23. Between 1970 and 1982 the total run size of the Henderson stock averaged 7% of the total run size of all three statistical area 23 stocks. The Henderson sockeye stock originates from Henderson Lake and Clemens Creek. All escapement estimates are made by foot surveys.

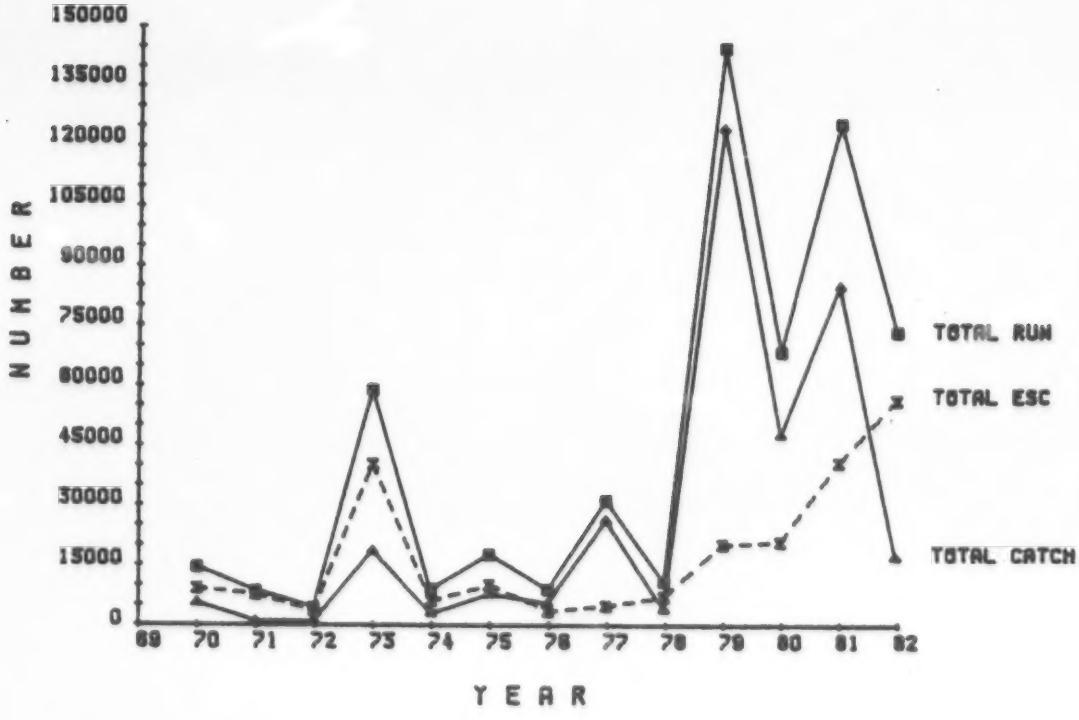
Henderson Lake sockeye approach their natal area from a westardly direction. The stock is exploited primarily by the Barkley Sound portion of the Area 23 fishery. Unlike the Great Central and Sproat Lake stocks however, the later returning individuals in the Henderson stock may also be exploited by the west coast of Vancouver Island troll fishery.

STOCK : HENDERSON LAKE

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE	HARVEST RATE
1970	14317	5317	9000	37.14
1971	8522	1022	7500	11.99
1972	4407	907	3500	20.58
1973	58495	18495	40000	31.62
1974	8936	2936	6000	32.86
1975	17635	7635	10000	43.29
1976	8825	5325	3500	60.34
1977	30860	26060	4800	84.45
1978	10832	3832	7000	35.38
1979	143488	123488	20000	86.06
1980	67869	47163	20706	69.49
1981	124586	84232	40354	67.61
1982	73027	16962	56065	23.23

There was no trend in the total run size or catch of the Henderson Lake sockeye stock between 1970 and 1978. However, following the 1978 fishing season there was a major increase in run size and catch as well as escapement. Harvest rates for the stock averaged 46% over the years 1970 to 1982.

The Henderson Lake sockeye first enter Barkley Sound in early May. Abundance peaks in the fishery in mid-July, slightly later than the Great Central and Sproat Lake stocks, and by late August most Henderson Lake sockeye have passed through the fishery.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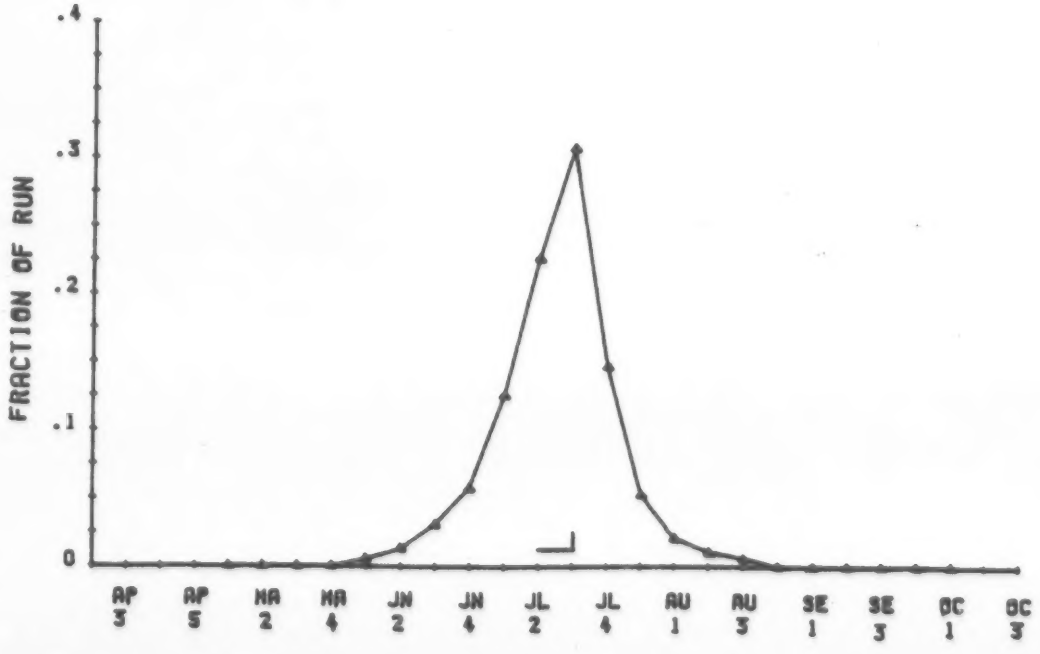
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South Coast

The south coast region is bounded on the north by Cape Caution (latitude 51° 09' N) and on the south by the border between the United States and Canada (DFO statistical areas 11 to 29). All the waters surrounding Vancouver Island are included in the region, with the exception of those in the Barkley Sound - Alberni Canal area (Fig. 11).

Sockeye production from the Fraser River dominates the catch of all fisheries in the South Coast region. The International Pacific Salmon Fisheries Commission (IPSFC) recognizes 8 to 10 major stocks (or races) and 30 to 40 minor stocks (or races) in the watershed. For the purposes of this report, the Fraser sockeye stocks have been divided into two major stocks based on run timing: the Early and Late stocks (each stock is an aggregate of several races; Table 11). Generally the Early stock is characterized by little delay off the mouth of the Fraser and enters the river between July and late August (or early September). The Late stocks typically delays 3 to 6 weeks off the mouth of the Fraser and then enters the river between early September and mid-October.

The other major Canadian sockeye producer in the region is the Nimpkish River, located at the northern end of Vancouver Island (Fig. 11). Four minor sockeye stocks are identified, all located in Johnstone or Georgia Straits (Fig. 11). The last stock dealt with in this region is located in Puget Sound (United States), where the major producer is the Cedar River which flows into Lake Washington.

The non-Fraser stocks tend to return earlier than the Fraser stocks (with the exception of the Early Stuart), beginning their terminal migration in early to mid-June, generally peaking by late June or early July and finishing before the end of July. Depending on the year, the terminal Fraser run will begin by late June and will then continue to the end of October. Because most Fraser races exhibit cyclic dominance (one or two years in every four years are much more abundant than the other years; Gilhousen, 1960), the abundance and timing of the composite stock will vary from year to year (Table 12). In general, the early run is more abundant than the late run in three years out of four. The late run, primarily due to the Adams River race, is most abundant in the 1982/1986 cycle, which is the most abundant of all four cycles.

Stocks returning to the Fraser River reach the mouth of the river either by traversing Johnstone and Georgia Straits or by passing through Juan de Fuca Strait (Fig. 11). Because the dominant route of travel has historically been through Juan de Fuca Strait, the proportion of fish utilizing the northern approach has been generally called the "diversion rate". This rate changes from year to year and is routinely estimated by the IPSFC. For the purposes of this analysis, the IPSFC estimate of "diversion rate" has been adopted (see Appendix 1 for details). Also, it is assumed that the Johnstone/Georgia Strait stocks approach exclusively from the north and that the Lake Washington stock approaches only from the south. All troll and net catch off the west coast of Vancouver Island are assigned to the southern approach.

The management of Fraser River sockeye stocks has been under the jurisdiction of the IPSFC since 1946. This agency has control of all waters off the west coast of Vancouver Island between the 48° 00' N and 49° 00' N latitude (except for Barkley Sound). It also has regulatory control of all southern approach waters in the Strait of Juan de Fuca, Puget Sound, and Georgia Strait (up to and including Statistical Area 17; see Fig. 11), as well as the Fraser River itself. The IPSFC has responsibility for all test fishing, escapement monitoring, and general assessment of Fraser River sockeye stocks. The assessment of the total run of Fraser River sockeye stocks is published annually, but detailed racial assessment (with the exception of escapement) is generally omitted.

There are 8 distinct commercial fisheries which harvest stocks originating from the South Coast region. There is a large troll fishery off the west coast of Vancouver Island, which is divided (in this analysis) into two parts at the 49th parallel. Prior to 1977, there existed a net fishery off the northwest end of Vancouver Island (Statistical Area 27; Fig. 11). This fishery only took substantial numbers of sockeye in 1974, 1975 and 1976, and smaller numbers in other years. Racial identification by the Department of Fisheries indicated that Central Coast stocks were present in this fishery as well as South Coast stocks. Therefore, in this analysis, this fishery is combined with the troll fishery in the same area, but some catch is excluded (Table 13).

The other major fisheries taking southern approach fish include (Fig. 11):

1) Juan de Fuca Strait or Statistical Area 20 (both seine and gillnet gear are used). There is fishing on both sides of the international boundary, although the Canadian fishery is usually in excess of 90% of the catch. The catch from both fisheries is combined in this analysis.

2) U.S. Net (seine, gillnet, and reef net). This fishery has two major centres of activity, Salmon Banks at the southern end of the San Juan Islands and Point Roberts just south of the mouth of the Fraser. There are other less important locations as well. For this analysis, all U.S. net fisheries in IPSFC convention waters have been combined into a single fishery (except for Juan de Fuca Strait).

3) District #1 (primarily gillnet, although there is some troll fishing as well as the occasional seine fishery off the islands on the east coast of Vancouver Island). This fishery also harvests north approach fish because it is the terminal fishing area for Fraser stocks. Early run stocks are almost exclusively harvested by gillnets in the main river channel (up to 80 kilometers from the mouth of the river). Late run stocks are harvested by gillnets either in the channel or off the mouth of the river in the shallow parts of the estuary.

The northern approach fish are taken in fisheries which include (Fig. 11):

1) Statistical Area 11 (troll and gillnet). This is a minor fishery off the north end of Vancouver Island.

2) Johnstone Strait (seine, troll, and gillnet). This is the major fishery harvesting north approach stocks and is largely a seine fishery. Because of its long length, this fishery has been divided into two parts for this analysis: Statistical Area 12 (upper Johnstone St.) and Statistical Area 13 (lower Johnstone St.).

3) Georgia Strait (seine, troll and gillnet). The net fishery is a small (mostly seine) fishery located in central Georgia Strait (Statistical Area 16 in this analysis).

There is also a major native food fishery on sockeye stocks in the Fraser River itself. Native catches in Johnstone Strait are usually included in with the commercial catches. There are also other minor fisheries in Puget Sound and Lake Washington which are directed on the Cedar River stocks; these catches are treated, like the native catches on the Fraser, by combining them with escapement to get total terminal run strength.

The locations of these fisheries have not changed a great deal over the years; however, their relative intensity has. In general, there has been an increase in the effective harvest rate of the fisheries located outside of the management control of the IPSFC. This has been particularly true of the Johnstone Strait seine fishery. In addition, new fisheries targetted on Fraser River sockeye have come into existence in areas north of Cape Caution (e.g., west coast of the Queen Charlotte Islands and Milbanke Sound near Bella Bella in the Central Coast). The result of this is an increase in the proportion of the catch of Fraser sockeye taken outside of the convention waters (see 1981 IPSFC Annual Report for more complete documentation). The existence of a sharing agreement with the United States results in sockeye taken in convention waters being shared evenly with the United States. However, outside of convention waters, all the catch accrues to Canada without the need for reciprocal sharing.

STOCK: SOUTH COAST TOTAL (INCLUDING LAKE WASHINGTON STOCK)

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPEMENT	EXPLOITATION RATE	% CATCH NATIVE●	% CATCH AREA 11	% CATCH AREA 12	% CATCH AREA 13	% CATCH AREA 16	% CATCH NON-CVN TROLL	% CATCH CONVENT TROLL	% CATCH AREA 20	% CATCH US NET	% CATCH DISTOT
1970	6381002	4242127	2138900	66.48	3.68	0.46	20.80	4.05	0.13	3.16	3.39	21.19	29.84	13.29
1971	8498113	7424799	1073400	87.37	5.76	0.01	6.89	1.72	0.41	5.36	2.53	22.78	35.99	10.56
1972	4189203	2986297	1202900	71.29	5.94	0.05	15.63	2.94	1.05	0.68	0.41	22.27	35.56	17.41
1973	7493299	5867705	1625600	78.25	3.38	0.16	5.95	1.32	0.27	1.05	0.90	25.43	43.48	18.75
1974	8982168	6917908	2064400	77.02	3.51	0.26	13.57	3.59	0.86	6.89	5.02	19.69	33.21	13.45
1975	4027467	2789962	1237400	69.27	9.50	0.02	5.54	0.87	0.17	4.93	0.97	7.81	51.21	18.98
1976	4770239	3695993	1074200	77.48	6.35	0.10	11.78	2.93	0.28	5.43	0.77	21.19	33.69	18.69
1977	4470152	3198297	1271200	71.57	6.63	0.22	9.13	3.52	2.63	0.33	0.67	15.30	37.77	24.81
1978	9790892	6974445	2821600	71.28	3.70	1.70	34.91	12.82	0.59	7.92	2.20	8.77	18.85	8.54
1979	6588842	4839222	1648800	74.46	4.31	0.17	9.92	10.80	0.65	2.87	3.56	8.09	35.19	22.44
1980	3576177	2335461	1240700	65.31	13.58	0.28	29.65	12.84	3.91	0.60	0.30	6.53	18.49	13.73
1981	7943124	6313139	1629900	79.48	7.26	0.25	37.39	10.72	4.69	0.44	0.27	3.79	13.79	13.79
1982	14227999	9838041	4389300	69.15	4.44	0.21	12.21	4.72	1.31	14.73	7.40	18.07	28.18	8.74

● include local catch in non-convention U.S. waters.

Sockeye stocks in this region are the largest in British Columbia and probably the second largest in the world (after Bristol Bay in Alaska). The total runs in this region varied from 3.6 million to 14.2 million in the period covered (1970 to 1982). However, trends are masked by the cyclic dominance phenomenon in Fraser River stocks. In general, the 1982/1986 cycle has increased over this period, while the other three cycles have shown little or no change, particularly the 1980/1984 cycle. The 1971 run was severely overfished and that cycle has performed only moderately since then. The proportional allocation of catch between the targetting fisheries varies from year to year and is a function of the "diversion rate" through Johnstone St. (the higher the diversion rate, the greater the proportion caught in the Area 12 and Area 13 fisheries).

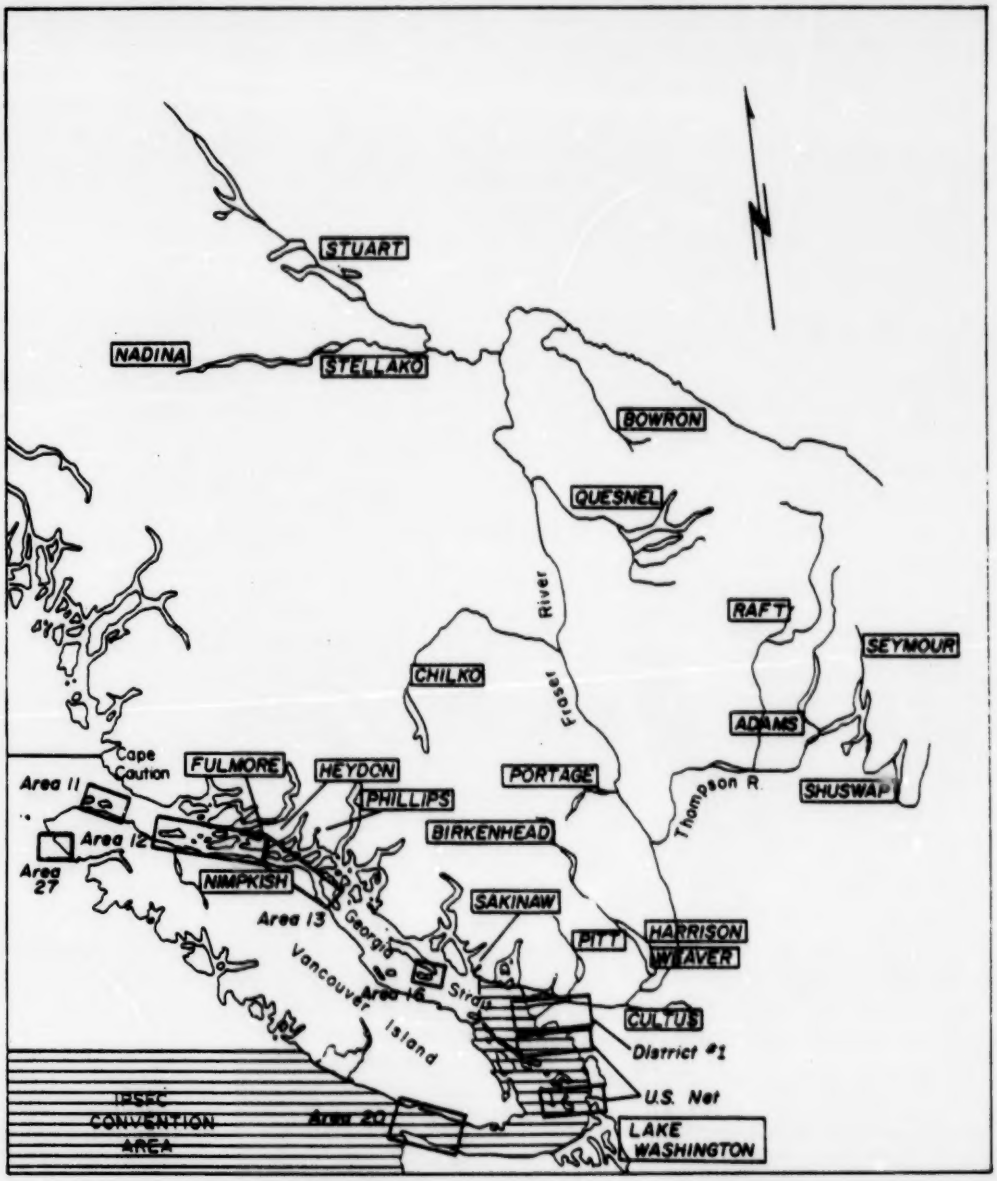


Fig. 11. The major sockeye salmon stocks (boldface type enclosed in boxes) and sockeye salmon fisheries (boldface type not enclosed in boxes) on the South Coast.

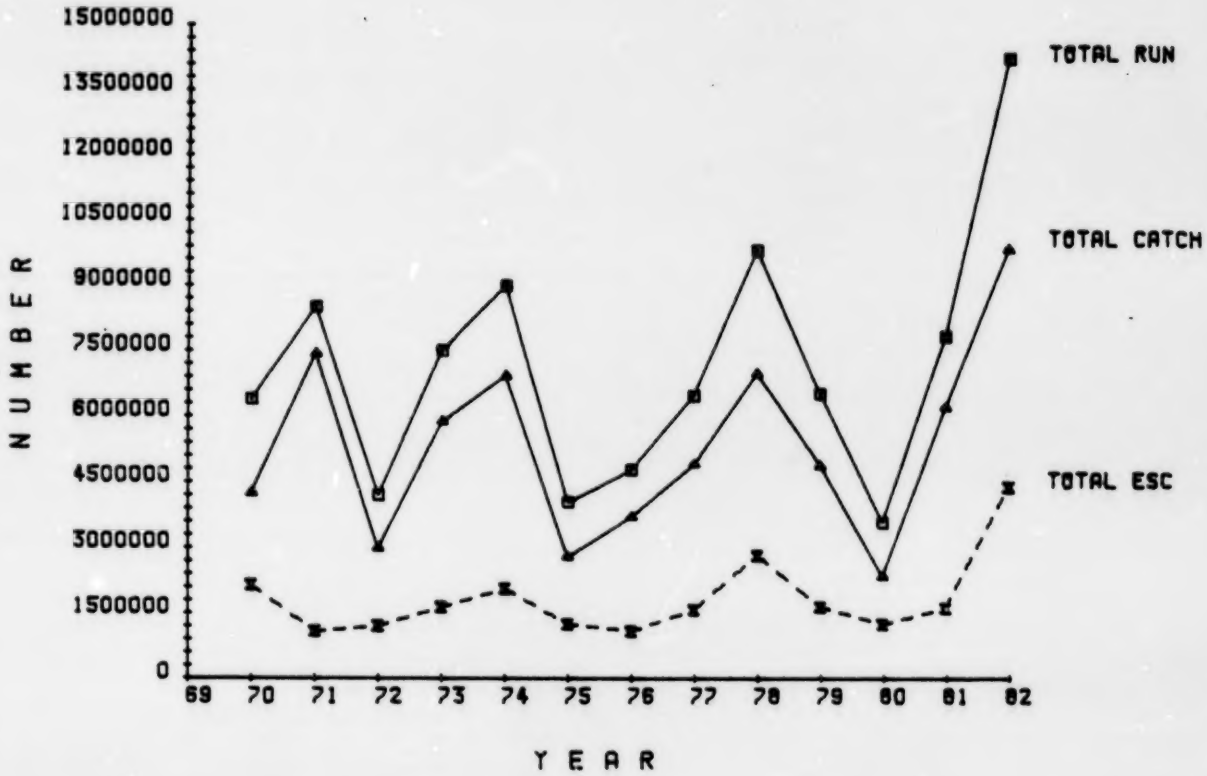


Fig. 12. Catch, escapement and total run size for South Coast sockeye salmon stocks, 1970 to 1982.

Table 11. Racial composition of the two composite Fraser River sockeye stocks. See Figure 11 for locations of these races.

	Early Fraser	Late Fraser
Major races:	Early Stuart	Adams
	Quesnel (Horsefly)	Lower Shuswap
	Late Stuart	Weaver
	Chilko	
	Stellako	
	Birkenhead	
Minor races*:	Pitt	Portage
	Nadina	Harrison
	Seymour	Cultus
	Raft	
	Bowron	
	Gates	

* Not a complete list.

Table 12. Approach timing and racial composition of the two Fraser River stocks used in this analysis.

	North Approach (peak timing through Area 12)	South Approach (peak timing through Area 20)
Early Fraser		
1980/1984 cycle (1)	late July/early August	late July/early August
1981/1985 cycle (2)	late July/early August	late July/early August
1982/1986 cycle (1)	early August	early August
1983/1987 cycle (3)	late July/early August	early August
Late Fraser		
1980/1984 cycle (4)	mid August	mid August
1981/1985 cycle (4)	mid/late August	mid/late August
1982/1986 cycle (5)	mid August	mid August
1983/1987 cycle (6)	mid/late August	mid/late August

Notes:

1) Dominated by the Chilko, Stellako, and Birkenhead races.

2) Dominated by Early Stuart, Late Stuart, and Quesnel. Chilko, Stellako and Birkenhead are also strong.

3) Chilko and Stellako are the major runs. Early and Late Stuart, Bowron, Seymour, Nadina and Birkenhead are also strong.

4) Weaver is the only strong run.

5) Adams and Shuswap dominate. Weaver is also strong.

6) Sub-dominant Adams run. Weaver is also strong.

Table 13. Allocation of catch in Statistical Area 27 net fishery to South Coast stock. Excluded catch is presumed to belong to Central Coast stocks. This fishery was eliminated after 1977.

Year	All catch excluded prior to this date	Proportion of catch included in-between cut-off dates	All catch included after this date
1970	July 11	N/A	July 12
1971	July 10	N/A	July 11
1972	July 8	N/A	July 9
1973	June 23	.5	July 15
1974	July 13	N/A	July 14
1975	July 12	.5	July 20
1976	July 3	.5	July 11
1977	July 2	.5	July 17

Note: Decisions regarding cutoff dates are based on relative strength of the Central Coast runs and which Fraser races were abundant in any particular year.

Table 14. Cut-off dates for distinguishing between Early and Late Fraser stocks in the test-fishing (escapement) timing curves. These cut-offs were determined from the curves themselves by choosing the apparent minimum and then calculating the proportional escapement on each side of the minimum. There is unavoidable error which results from the misallocation of stocks in the overlap period. The timing curve for the Late Fraser stock is often compressed (see text). To correct for this, a binomial escapement timing curve was fitted, using the peak from the test-fishing curve. The number of weeks of delay for the Late Fraser stock at the mouth of the Fraser River is also indicated.

Year	Early/Late Stock Cut-off date	Type of Escapement Timing Curve Used for Late Run	Amount of Delay by Late Stocks at Mouth of Fraser (weeks)
1970	Sept. 1	test fishing	3
1971	Sept. 8	binomial	3 1/2
1972	Sept. 16	binomial	4
1973	Sept. 5	test fishing	4
1974	Aug. 28	test fishing	3
1975	Sept. 2	test fishing	3 1/2
1976	Sept. 8	binomial	4
1977	Sept. 5	test fishing	3
1978	Aug. 31	test fishing	3
197[illegible]	Sept. 1	binomial	3 1/2
1980	Sept. 10	test fishing	4
1981	Sept. 15	test fishing	3 1/2
1982	Sept. 4	binomial	4

Nimpkish Sockeye

The Nimpkish sockeye stock is located at the northern end of Vancouver Island (Fig. 11). The commercial fisheries exploiting this stock are the Statistical Area 11 fishery and the part of the Statistical Area 12 fishery located at the top end of Johnstone St. near Malcolm Island. This last fishery has been curtailed in recent years at peak Nimpkish migration times to protect this stock for conservation purposes. There is also a native food fishery which takes place at the mouth of the river. (This fishery was closed in 1982.)

The system supporting this stock is large and complex. Escapement enumeration is additionally difficult because of the presence of large numbers of lake spawners. Recent hydro-acoustic estimates of smolt populations in Lake Nimpkish (K. Hyatt, Pacific Biological Station, pers. comm.) indicate that the spawning stocks may be seriously underestimated.

The timing of this stock is earlier than the Early Fraser stock, peaking at Malcolm Island in Johnstone St. in early to mid-July. There is an early component to this stock which is present from mid-May onwards. As the early run is usually not fished, no stock abundance data is available. The IPSFC and the Department of Fisheries and Oceans routinely sample the Johnstone St. fisheries for the presence of non-Fraser stocks. These are identified through scale patterns; test fishery CPUE provide the timing data. It is assumed that this stock approaches the spawning grounds entirely through Johnstone Strait.

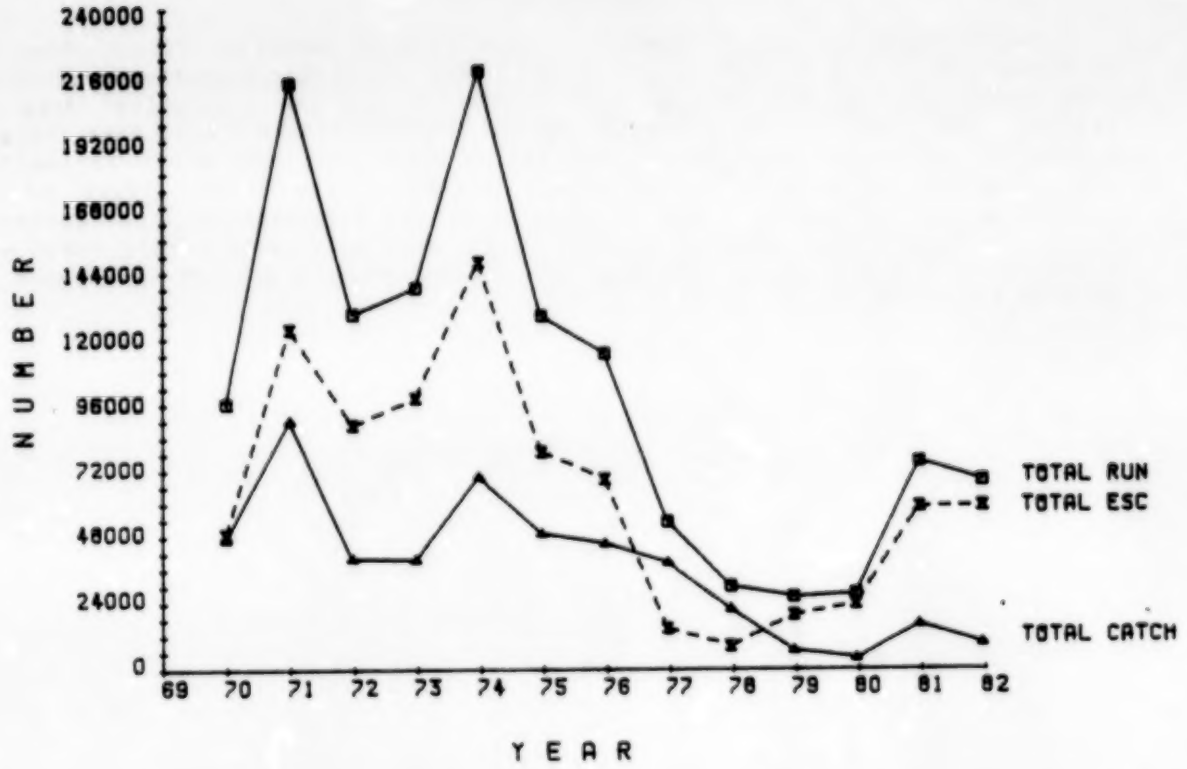
STOCK: NIMPKISH

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPEMENT	EXPLOITATION RATE	% CATCH NATIVE	% CATCH AREA 11	% CATCH AREA 12
1970	97949	47947	50000	48.95	0.00	0.40	99.60
1971	216442	91440	125000●	42.25	0.00	0.02	99.98
1972	130454	40656	90000●	31.12	11.51	0.69	87.80
1973	140386	40384	100000	28.77	13.19	1.89	84.92
1974	220759	70761	150000	32.05	8.63	2.13	89.23
1975	130008	50006	80000●	38.46	12.00	0.41	87.59
1976	116302	46302	70000●	39.81	4.75	0.92	94.33
1977	54293	39289	15000	72.36	17.82	1.14	81.04
1978	30471	21971	8500	72.10	27.31	1.48	71.21
1979	26713	6717	20000	25.14	0.00	1.46	98.54
1980	27963	3963	24000	14.17	10.09	2.89	87.02
1981	76354	16354	60000	21.42	1.83	0.58	97.58
1982	69363	9362	60000	13.50	0.00	2.62	97.38

(●) Note: These escapements have been adjusted upward.

Escapements were adjusted upwards in the indicated years because other sources (Anderson, 1974; IPSFC Annual Reports) indicated larger contributions of non-Fraser stocks in the Area 12 fishery.

This analysis indicates substantial total stock decline since 1970. Total exploitation rates in the early 1970's averaged about 40%. Since 1980, when the regulatory measures were begun, exploitation rates have been more than halved to under 20%, indicating the success of the measures. Even if the escapements are underestimates, the pattern of stock change would be the same.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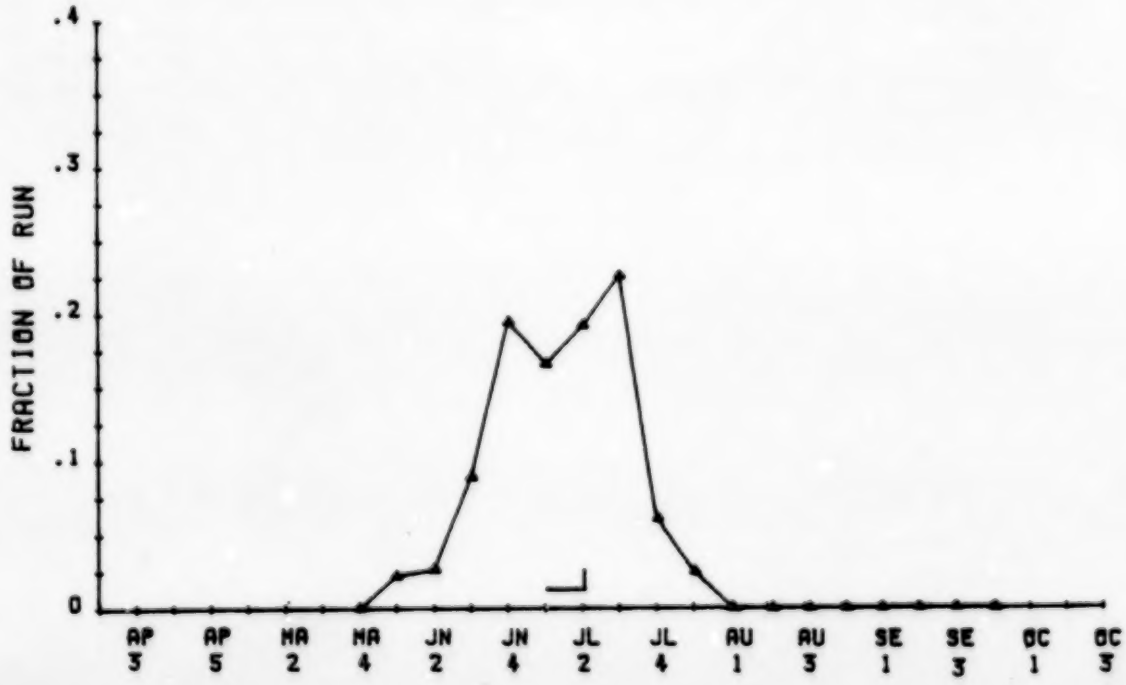
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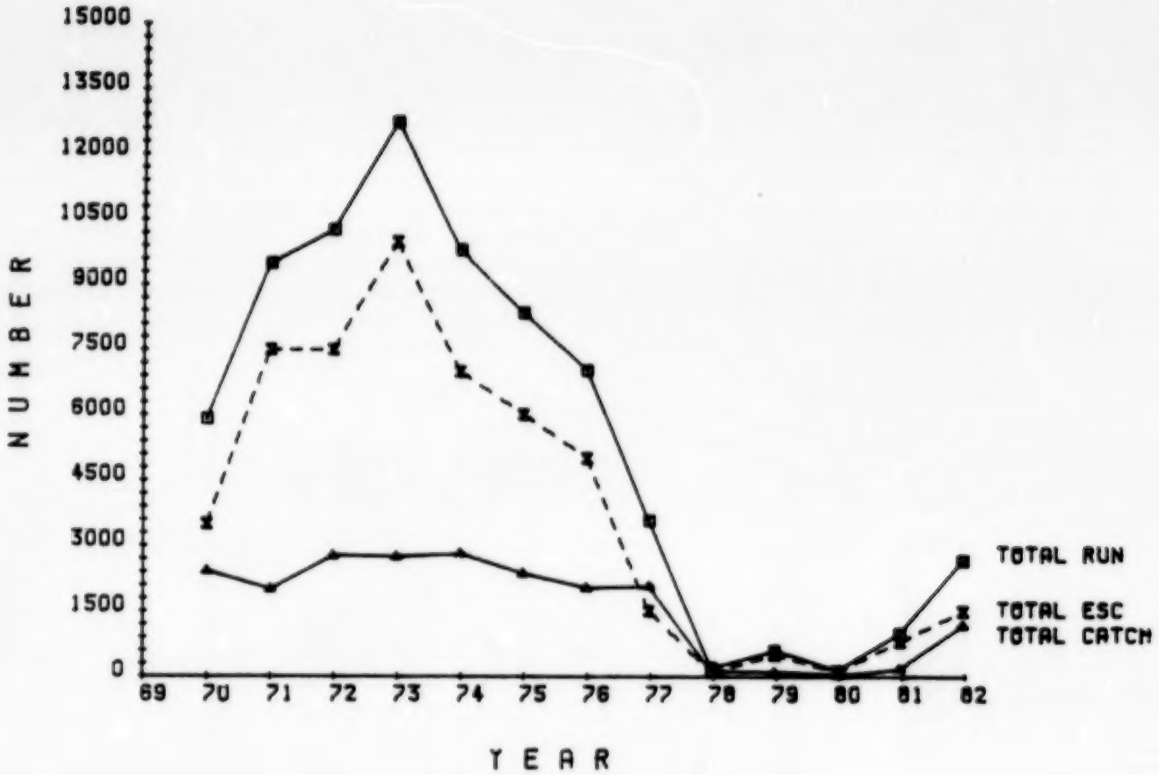
Fulmore Sockeye

Fulmore Lake is located on the mainland side of Johnstone Strait about 50 to 60 km east of the top end of the Strait. The commercial fisheries exploiting this stock are the Statistical Area 11 fishery and the Statistical Area 12 fishery. Protection measures instituted for Nimpkish stocks should have minimal beneficial effect on this stock. The system supporting this stock is smaller than Nimpkish; however, the escapement estimates are still likely to be underestimates. The peak timing of this stock was estimated by local managers to be the same as the Nimpkish stock. A binomial escapement timing curve was fitted to this information. The approach to the spawning grounds is assumed to be from the north.

STOCK: FULMORE

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE-MENT	EXPLOIT-ATION RATE	% CATCH AREA 11	% CATCH AREA 12
1970	5911	2413	3500	40.82	0.43	99.57
1971	9496	1996	7500	21.02	0.02	99.98
1972	10266	2766	7500	26.94	1.00	99.00
1973	12742	2742	10000	21.52	2.05	97.95
1974	9806	2808	7000	28.64	2.35	97.65
1975	8348	2348	6000	28.12	0.42	99.58
1976	7024	2024	5000	28.81	1.36	98.64
1977	3569	2067	1500	57.92	1.53	98.47
1978	207	105	100	50.75	1.69	98.31
1979	595	93	500	15.67	2.74	97.26
1980	131	29	100	21.98	2.10	97.90
1981	983	181	800	18.43	1.29	98.71
1982	2671	1169	1500	43.77	0.88	99.12

This analysis indicates substantial total stock decline since the early 1970's. This largely reflects the pattern of escapement estimates. The total exploitation rates are estimated in the 20-40% range. There appears to be little change in the magnitude of the total exploitation rate over the period of this analysis.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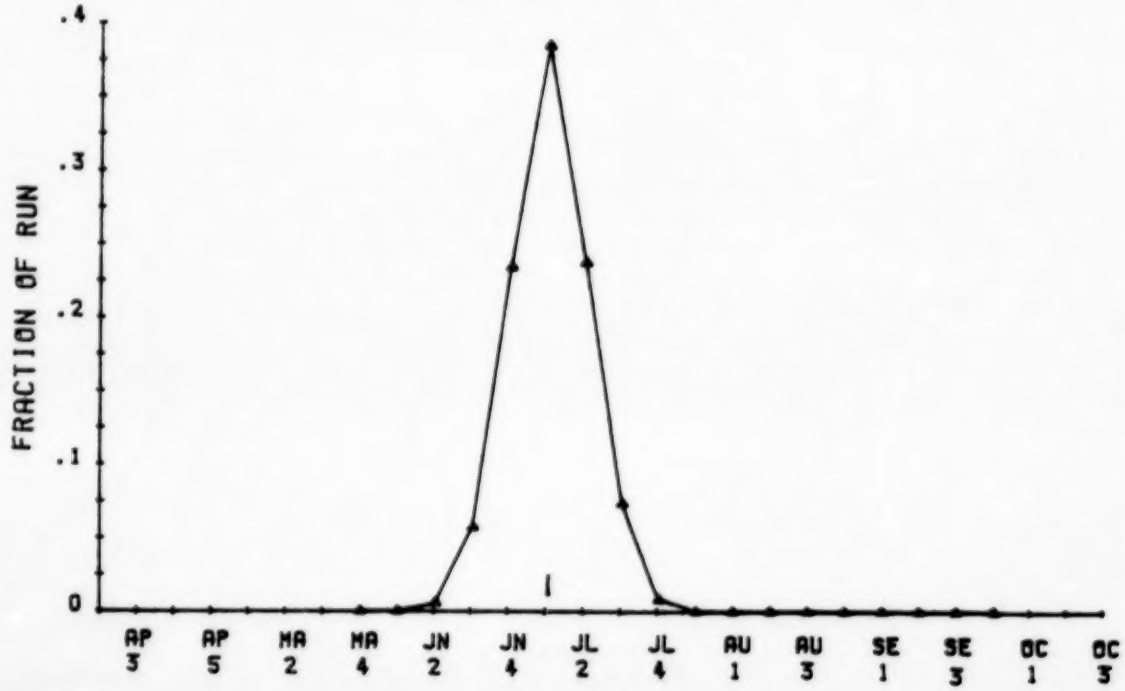
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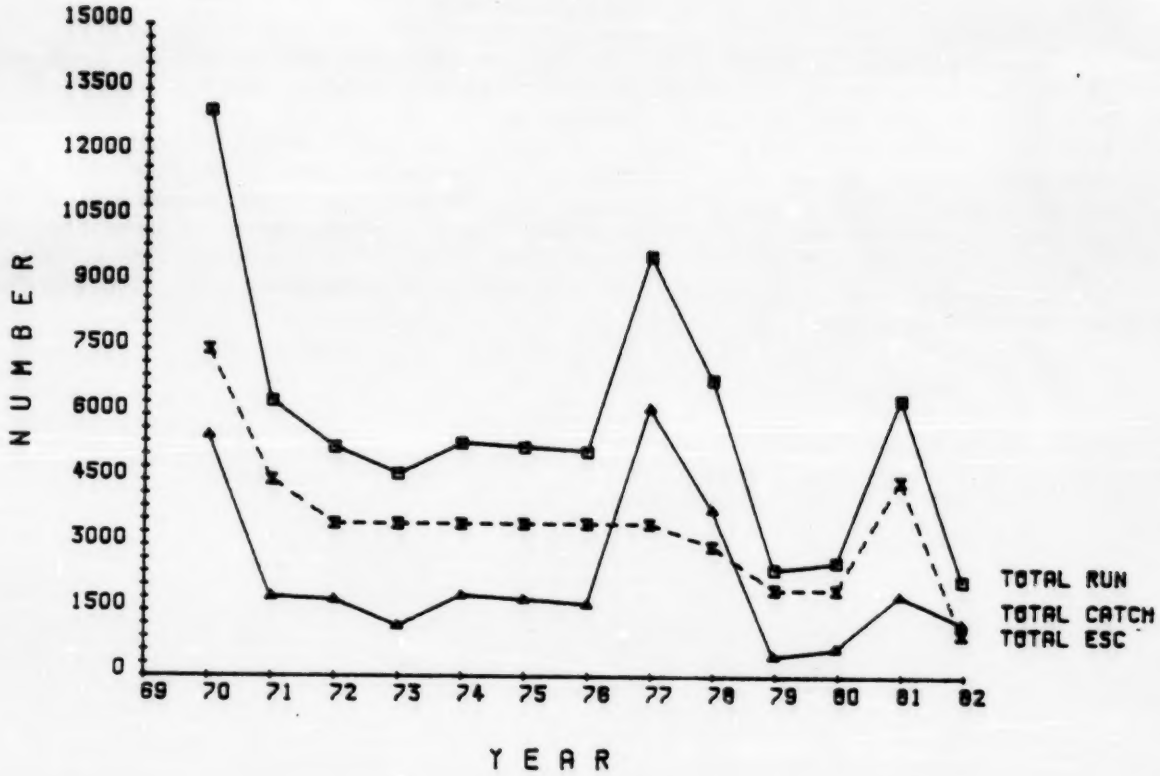
Heydon Sockeye

Heydon Lake is located on the mainland side of Johnstone Strait about 25 km to the east of Fulmore Lake on the west side of Loughborough Inlet. In addition to being exploited by the fisheries in Statistical Areas 11 and 12, this stock is also vulnerable to the fishery at the top end of Statistical Area 13. Therefore, the regulations designed to protect Nimpkish stocks should have only small benefits for this stock. This is a relatively small system and the escapements are low again, there is potential for the underestimation of the escapement. The peak timing of this stock was estimated by area managers to be one-half week later than the Nimpkish stock. A binomial escapement timing curve was fitted to this information. The approach to the spawning grounds is assumed to be from the north.

STOCK: HEYDON

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE-MENT	EXPLOIT-ATION RATE	% CATCH AREA 11	% CATCH AREA 12	% CATCH AREA 13
1970	13023	5523	7500	42.41	0.43	93.13	6.44
1971	6314	1812	4500	28.70	0.02	66.32	33.67
1972	5251	1753	3500	33.38	0.84	72.91	26.25
1973	4641	1143	3500	24.63	1.86	82.34	15.80
1974	5352	1854	3500	34.64	2.06	74.01	23.92
1975	5257	1759	3500	33.46	0.41	77.58	22.01
1976	5148	1650	3500	32.05	1.27	84.86	13.87
1977	9648	6150	3500	63.75	1.63	77.16	21.21
1978	6819	3821	3000	56.03	1.66	79.60	18.73
1979	2462	464	2000	18.84	2.27	75.78	21.95
1980	2640	642	2000	24.32	1.94	85.98	12.08
1981	6369	1867	4500	29.32	0.91	53.69	45.40
1982	2221	1225	1000	55.16	0.79	62.80	36.42

This analysis seems to show a slight overall decline in total stock abundance in the period 1970 to 1982. The pattern of total exploitation rates varies from about 20 to 45%, with the exception of 1977 and 1978. The non-Fraser stocks appear to have been exploited at higher rates in these two years than in the other years. This is true for all five stocks. The only apparent explanation is that there were large catches in the earlier fisheries in those years, and, although the Fraser stocks predominated, the amount of catch assigned to these stocks was high relative to the other years. Or alternatively, the estimates of spawning escapements were more of an under-estimate than in the other years.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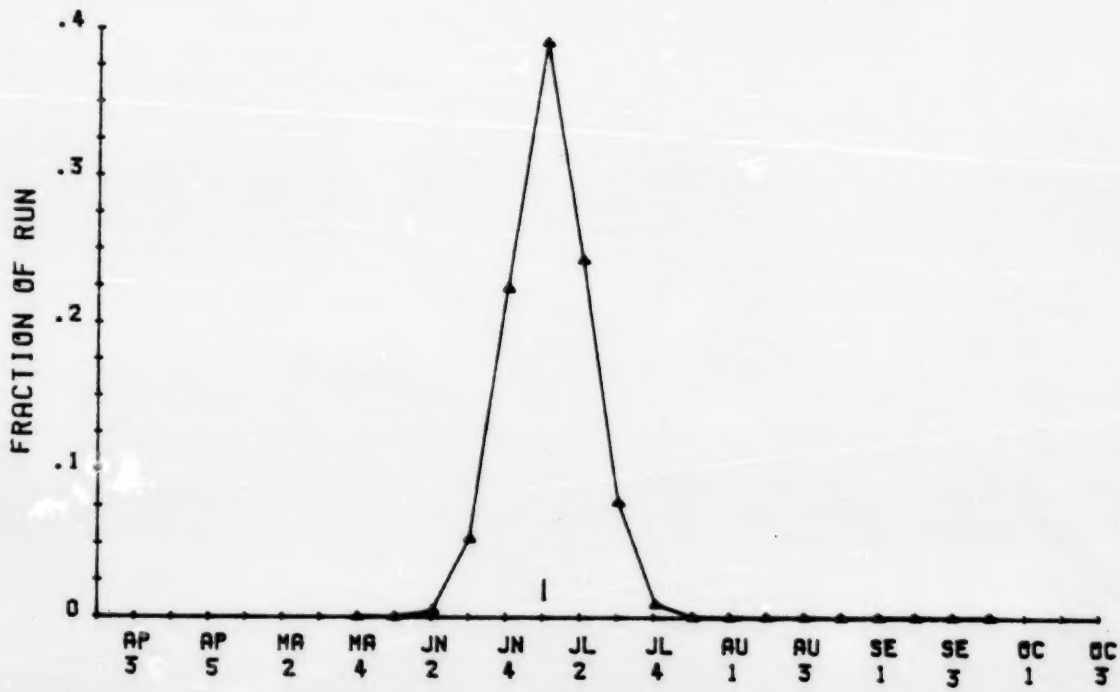
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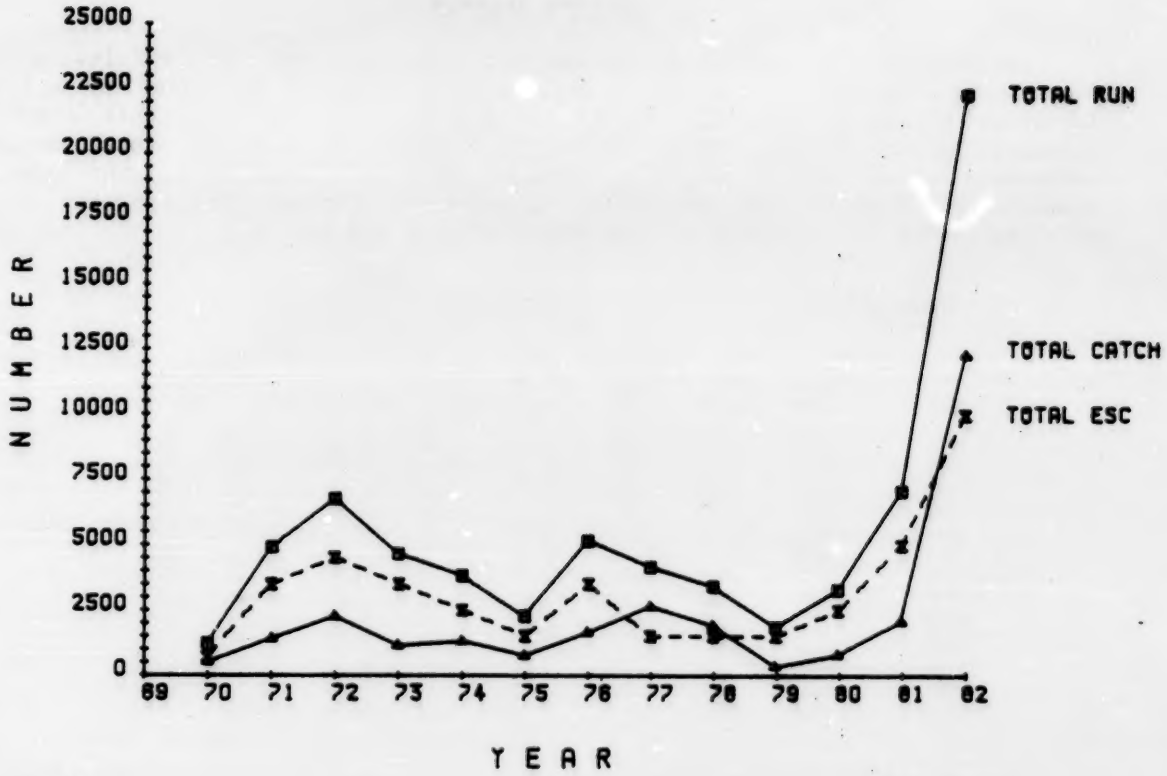
Phillips Sockeye

Phillips Lake is located at the head of Phillips Arm on the mainland side of Johnstone Strait. It is about 20 km to the east of Heydon Lake. It is exploited by the same commercial fisheries as the Heydon stock: Statistical Area 11, Statistical Area 12 and the upper end of Statistical Area 13. The regulations designed to benefit Nimpkish stocks do not affect this stock. It is a small system and is subject to error in the estimation of escapement as are all the non-Fraser stocks. It is presumed by local managers to have the same timing as the Heydon stock, one-half week later than the Nimpkish stock. A binomial escapement timing curve was fitted to this information. The approach to the spawning grounds is assumed to be from the north.

STOCK: PHILLIPS

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE-MENT	EXPLOIT-ATION RATE	% CATCH AREA 11	% CATCH AREA 12	% CATCH AREA 13
1970	1221	519	700	42.51	0.42	93.13	6.44
1971	4908	1410	3500	28.73	0.02	66.37	33.61
1972	6757	2255	4500	33.37	0.84	72.90	26.26
1973	4641	1143	3500	24.63	1.86	82.34	15.80
1974	3825	1325	2500	34.65	2.06	74.01	23.93
1975	2256	754	1500	33.41	0.41	77.51	22.08
1976	5148	1650	3500	32.05	1.27	84.86	13.87
1977	4141	2639	1500	63.73	1.63	77.14	21.23
1978	3417	1915	1500	56.04	1.67	79.61	18.73
1979	1854	352	1500	18.97	2.25	75.92	21.83
1980	3303	803	2500	24.31	1.94	85.97	12.09
1981	7073	2073	5000	29.31	0.91	53.66	45.43
1982	22300	12300	10000	55.16	0.79	62.80	36.41

No clear trend can be seen in the level of stock abundance except for a sharp rise in the last two years. No explanation is available. Exploitation rates fluctuate in the same range as the other non-Fraser stocks: about 20 to 45%. The years 1977 and 1978 show elevated exploitation rates.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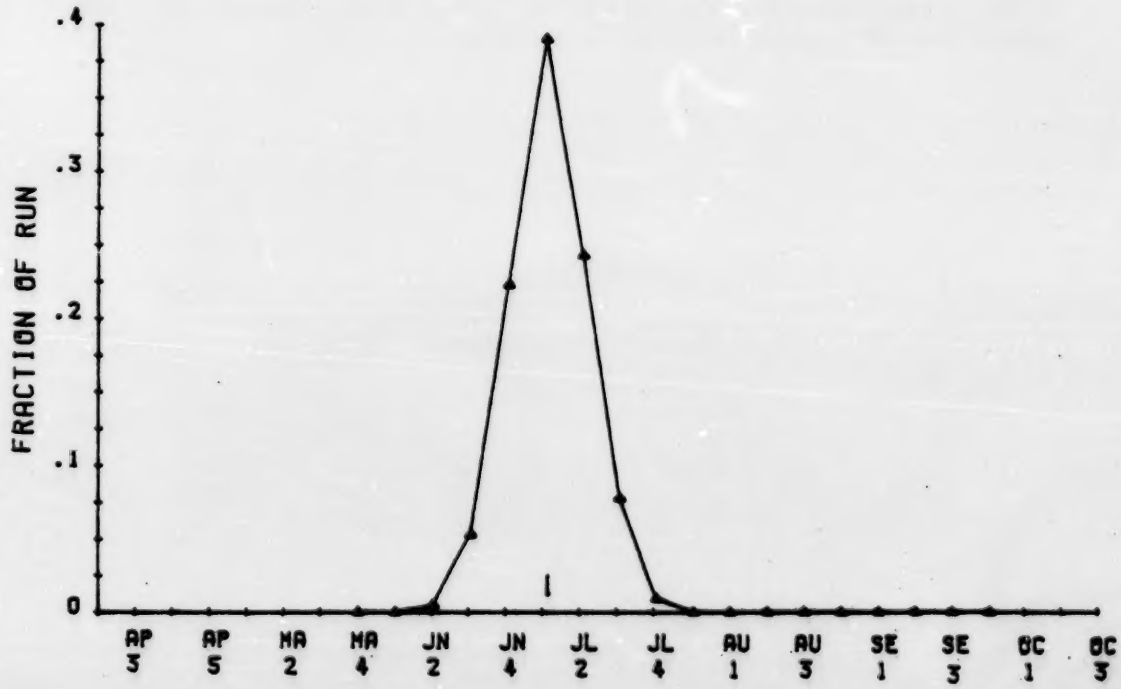
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Sakinaw Sockeye

Sakinaw Lake is located on the Sechelt peninsula near Jervis Inlet, midway down Georgia Strait (Fig. 11). In addition to being exploited by all the Johnstone Strait fisheries (Statistical Area 11, 12, and 13), this stock is harvested by the Georgia Strait fishery in Statistical Area 16. Local managers estimate that the peak timing of this stock is a full week behind the Nimpkish stock, and a binomial escapement timing curve was fitted. The approach to the spawning grounds is assumed to come entirely from the north.

STOCK: SAKINAW

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE-MENT	EXPLOIT-ATION RATE	% CATCH AREA 11	% CATCH AREA 12	% CATCH AREA 13	% CATCH AREA 16
1970	9355	4355	5000	46.55	0.38	87.88	5.45	6.29
1971	16118	8118	8000	50.37	0.01	59.38	13.37	27.24
1972	7467	2965	4500	39.71	0.69	65.95	19.97	13.39
1973	2104	602	1500	28.60	1.54	69.69	12.85	15.91
1974	11608	5608	6000	48.31	1.32	60.24	13.58	24.86
1975	24803	8801	16000	35.48	0.38	74.68	20.12	4.82
1976	8925	2925	6000	32.77	1.24	83.80	13.46	1.50
1977	3596	2396	1200	66.63	1.52	76.81	18.69	2.98
1978	9243	5239	4000	56.68	1.63	79.31	18.24	0.83
1979	13773	2775	11000	20.15	2.11	71.81	20.37	5.71
1980	3708	910	2800	24.55	1.92	85.43	11.94	0.72
1981	4267	1269	3000	29.75	0.90	53.59	44.47	1.05
1982	7989	4587	3400	57.42	0.77	63.58	33.23	2.42

This analysis shows a pattern of cyclic dominance for this stock, repeating every four years beginning in 1971. There is a sub-dominant year which cycles every four years from 1970. No overall stock trend is evident. Exploitation rates reflect the extra fishery this stock is subject to and are generally higher than those for the Johnstone St. stocks. These vary from 20 to 55%, except for 1977 and 1978, which are higher.

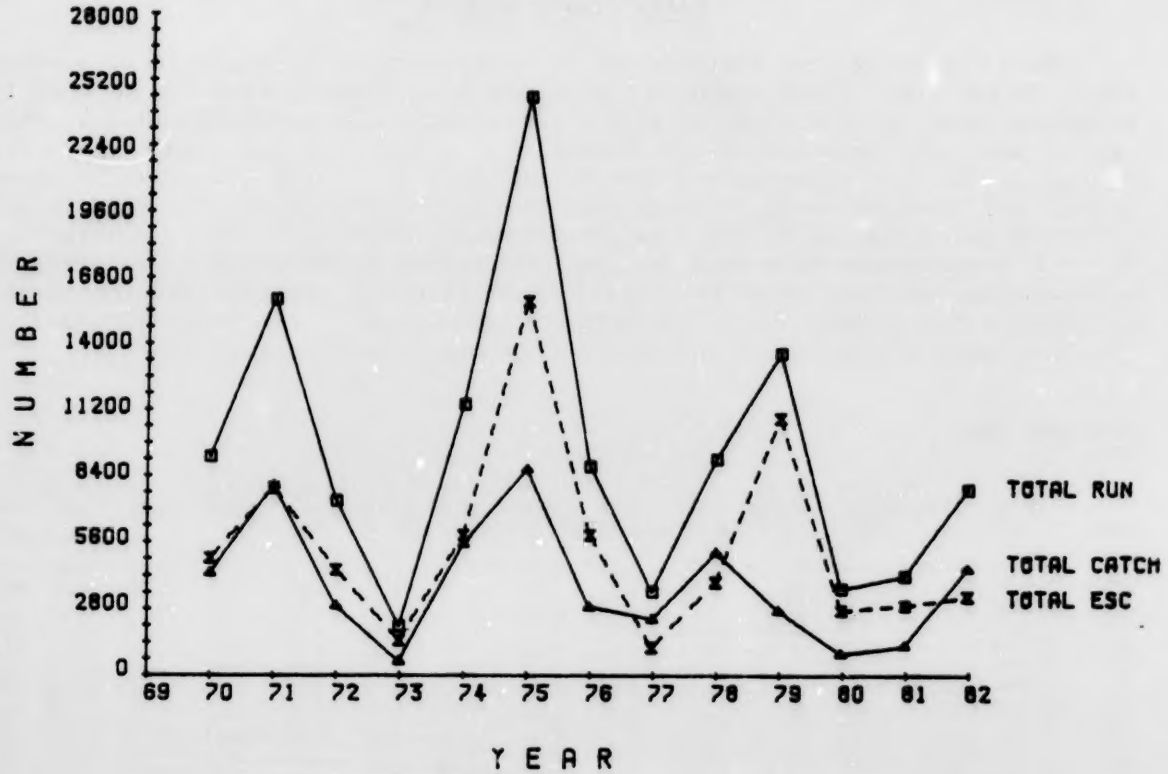
Early Fraser Sockeye

The stock designated Early Fraser in this report is a composite of several races (Table 11). These races all have migration timings which cause them to enter the river mouth in July or August (or occasionally early September). They rarely delay off the mouth of the Fraser in the Gulf of Georgia more than a day or two. This stock approaches the Fraser from the north (through Johnstone Strait) and from the south (through Juan de Fuca Strait) and is harvested by all the fisheries discussed in the Area Introduction. Escapement timing information for this stock comes from test fishing information in the Fraser. As there is no available information on the racial composition in the test fishing catch, the distinction between Early and Late Stocks is made by examining the shape of the escapement timing curve, and varies from year to year (Table 14).

STOCK: EARLY FRASER

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE-MENT	EXPLI-ATION RATE	% CATCH NATIVE	% CATCH AREA 11	% CATCH AREA 12	% CATCH AREA 13	% CATCH AREA 16	% CATCH NON-CVN TROLL	% CATCH COVENT TROLL	% CATCH AREA 20	% CATCH US NET	% CATCH DISTAL
1970	1910270	1601958	308300	83.86	6.78	0.35	9.55	2.61	0.11	4.10	2.72	32.00	29.46	12.32
1971	3986995	3563423	423600	89.38	3.87	0.01	5.67	1.57	0.58	4.89	2.01	21.03	34.74	25.63
1972	3570429	2773263	797200	77.67	4.77	0.04	13.62	2.81	0.98	0.68	0.43	20.95	37.69	18.03
1973	6385437	5272732	1112700	82.57	3.05	0.15	4.31	1.20	0.39	0.98	0.84	25.01	45.02	19.13
1974	2229160	1795911	433200	80.56	9.24	0.26	11.75	1.91	0.83	8.07	3.70	16.10	32.11	16.01
1975	2755574	1984928	770600	72.03	11.89	0.02	3.37	0.76	0.12	5.53	0.53	8.09	49.52	20.18
1976	4010834	3256222	754700	81.18	6.92	0.09	10.82	2.48	0.29	5.69	0.75	19.27	35.46	18.23
1977	5287004	4255907	1031100	80.50	5.70	0.13	6.89	2.48	2.57	0.91	0.66	15.83	36.50	28.33
1978	2137501	1660408	477100	77.68	10.54	2.96	28.11	5.18	0.32	13.46	3.59	6.73	16.90	12.20
1979	4843410	3875536	967900	80.02	6.90	0.14	7.36	9.41	0.04	2.64	3.76	7.19	34.68	27.88
1980	2724072	1962956	761100	72.06	9.20	0.29	31.59	13.42	4.12	0.61	0.25	6.90	19.81	13.82
1981	7335900	5958256	1377600	81.22	7.33	0.26	36.36	10.65	4.56	0.42	0.24	5.69	20.26	14.23
1982	3237423	2620787	616600	80.95	10.68	0.10	7.08	3.05	0.45	12.89	8.96	11.04	29.60	16.15

The Early Fraser stock shows a strong pattern of cyclic dominance, peaking in 1973, 1977, and 1981. This is the cycle year that was predominant in the Fraser prior to the Hell's Gate slide. It is largely made up of the Early and Late Stuart and the Quesnel (Horsefly) races. The Chilko, Stellako, and Birkenhead races make up the balance of the run (Table 12). It is largely made up of the Late Stuart and the Quesnel (Horsefly) races. The year 1979 also returned quite strongly even though it is out of the dominance pattern. There appears to be no overall trend in this time period, although the weakest cycle (1982/1986) appears to be increasing (see Appendix 1). Over a longer time period (from prior to IPSFC management control), the trend appears to be generally upward, especially for the dominant cycle. The timing curve reflects the timing at the northwest end of Vancouver Island. The "knee" at its beginning is due to the Early Stuart race.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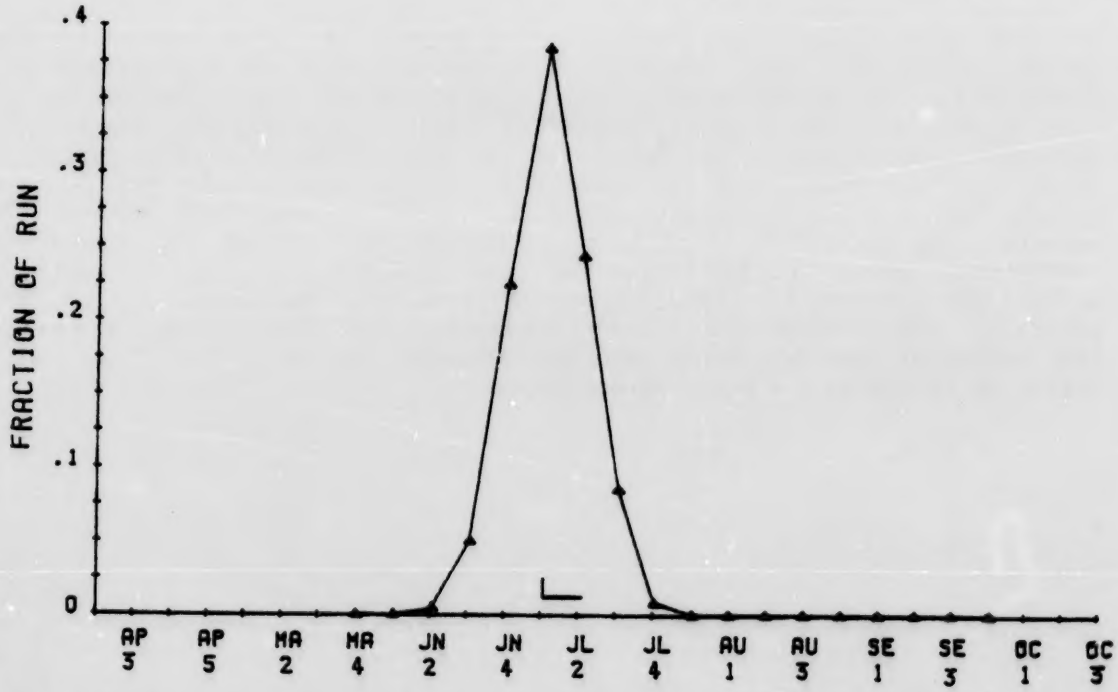
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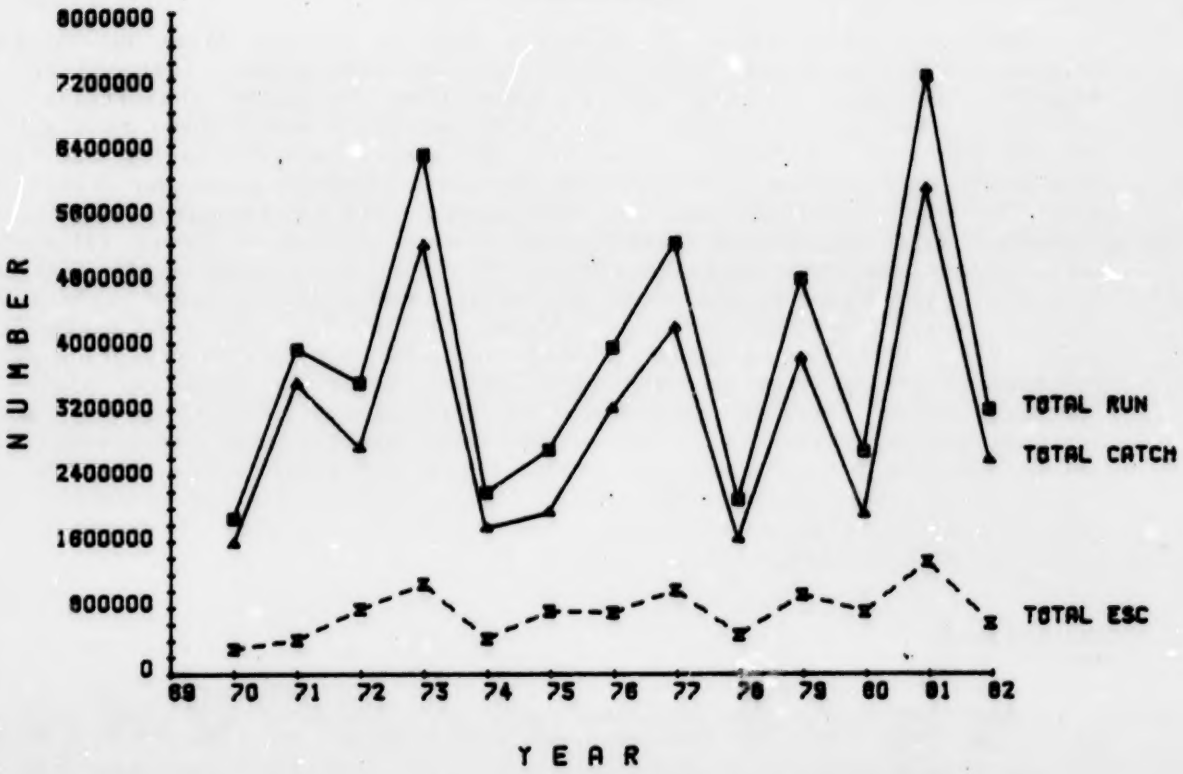
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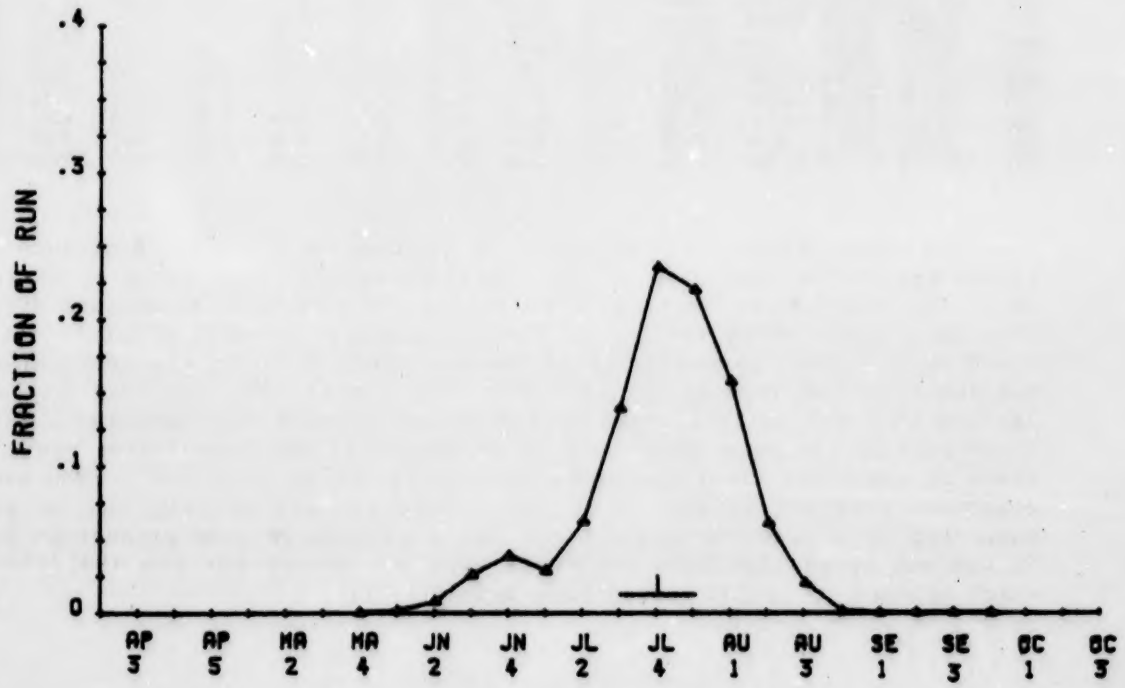
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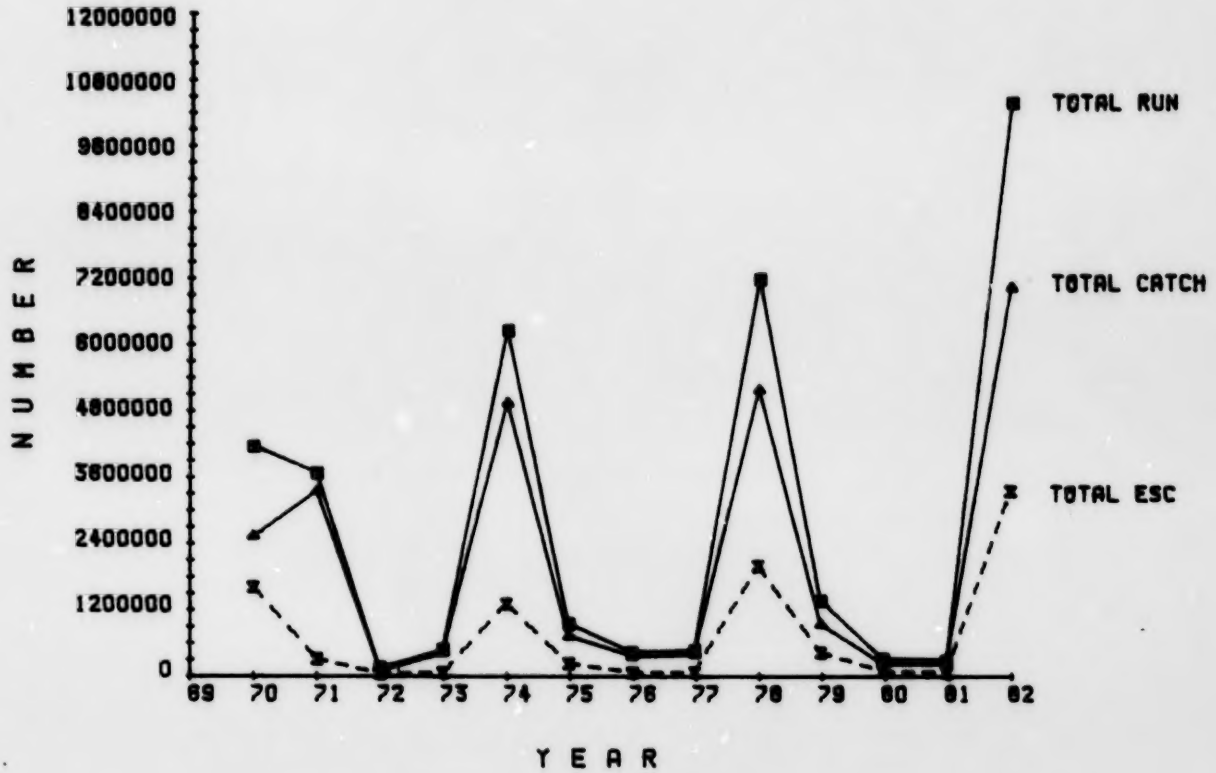
Late Fraser Sockeye

The Late Fraser stock is primarily made up of the Adams River, Lower Shuswap and Weaver races; other minor races are also present (Table 12). The migration pattern of these races cause them to enter the Fraser from early-September to mid-October. They also typically delay three to six weeks off the mouth of the Fraser in the Gulf of Georgia before entering the river. This stock approaches the Fraser from the north (through Johnstone Strait) and from the south (through Juan de Fuca Strait) and is harvested by all the fisheries discussed in the Area Introduction. Escapement timing information comes from river test-fishing catches; the distribution between the Early and Late stocks is based on the shape of the escapement timing curves (the lowest point in early September is usually chosen; Table 14). For some years (e.g. 1972, 1978, 1982), the escapement timing curves for the Late Fraser stock seemed compressed, giving rise to very high harvest rates in fisheries along the approach routes (because very few fish were present) or to highly skewed approach timing curves (30 to 50% of the total stock in the first week). To solve this problem, a binomial escapement timing curve was fitted using the peak timing from the test-fishing curve (Table 14). Similar problems were experienced if the delay at the mouth of the river from this stock was set too short or too long (Table 14).

STOCK: LATE FRASER

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE-MENT	EXPLOI-ATION RATE	% CATCH NATIVE	% CATCH AREA 11	% CATCH AREA 12	% CATCH AREA 13	% CATCH AREA 16	% CATCH NON-CVN TROLL	% CATCH COVENT TROLL	% CATCH AREA 20	% CATCH US NET	% CATCH DIST01
1970	4213640	2573770	1639900	61.08	1.65	0.53	26.02	5.03	0.14	2.64	3.89	15.01	30.04	14.24
1971	3722357	3404030	318300	91.45	0.44	0.02	6.14	2.04	0.23	6.54	3.39	27.14	40.40	13.66
1972	164285	117523	46700	71.54	1.71	0.04	40.57	7.00	3.04	0.30	0.37	15.89	14.25	16.82
1973	[illegible]	[illegible]	[illegible]	[illegible]	0.47	0.08	6.89	3.11	0.02	1.85	1.73	37.58	26.28	21.18
1974	6349159	5013022	1336100	78.96	1.12	0.23	13.09	4.24	0.77	6.55	5.69	21.25	34.33	12.83
1975	969224	729428	239800	75.26	2.36	0.01	4.33	0.35	0.26	3.76	2.26	7.08	61.09	17.69
1976	[illegible]	[illegible]	[illegible]	[illegible]	1.00	0.08	8.88	7.32	0.29	3.58	1.60	30.37	18.73	20.68
1977	[illegible]	[illegible]	[illegible]	[illegible]	1.01	1.17	22.73	18.42	1.23	0.34	0.58	6.88	11.53	36.90
1978	7501172	5263910	2037200	72.10	1.15	1.31	36.94	15.32	0.88	6.24	1.78	5.47	19.63	7.48
1979	1393128	953157	440000	68.42	2.39	0.27	19.70	16.73	0.08	3.74	4.78	11.82	30.43	2.06
1980	316259	229038	87200	72.43	2.51	0.26	29.27	15.79	4.56	0.48	0.20	6.46	18.78	21.73
1981	283242	218212	65000	77.02	1.89	1.15	61.31	13.11	3.44	0.94	0.47	7.30	9.14	1.01
1982	10555440	7147820	3407600	67.72	1.69	0.24	13.91	5.29	1.64	15.46	6.90	20.79	27.94	6.14

The Late Fraser stock shows a pattern of cyclic dominance heavily influenced by the magnitude of the 1982/1986 cycle. This cycle is largely made up of the Adams River race, with an increasing component of Shuswap River fish. This is a cycle which emerged in dominance since the Hell's Gate slide and is based on the great productivity of Shuswap Lake. Although the Adams River has a sub-dominant run peaking in the 1979/1983 cycle, this run was exploited at greater than 90% in 1971 and does not appear to have yet recovered. The Weaver Creek race is the only other race of abundance in the Late Fraser stock and, in years of low Adams River abundance (e.g. 1972, 1973, 1976, 1977, 1980 and 1981), comprises over 80% of the total run. This is because this run is partially supported by a spawning channel and has a relatively even production schedule. No overall trends for this stock are apparent except for the 1982/1986 cycle, which appears to be increasing (see Appendix 1).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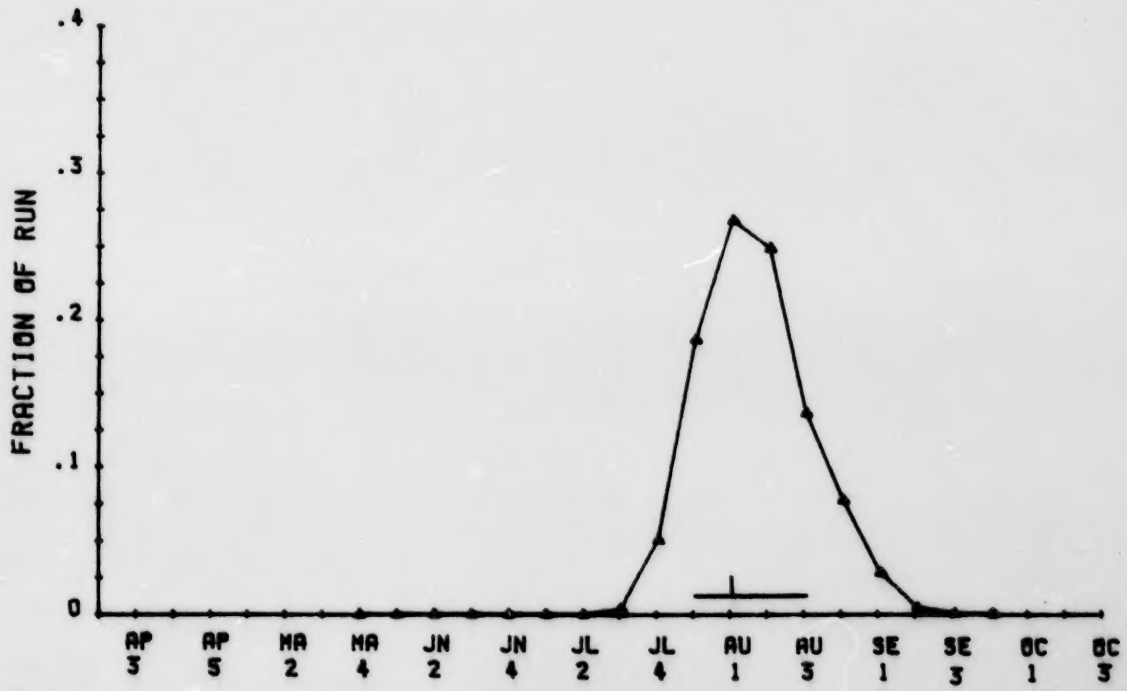
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Summary

This report has presented an analysis of British Columbia sockeye salmon stocks from 1970 to 1982. While there are many genetically distinct sockeye stocks in the province, from a fishery management perspective many of these can be aggregated into stock groupings, using such criteria as common geographical location, timing or migration routing. Consequently the term 'stock' as used in this report may refer either to a genetically distinct population or to an aggregation of such populations, depending on management requirements.

The results presented herein were obtained using the run reconstruction methodology. Key inputs to the process are: catch by fishery, escapement by stock, timing of escapement, and migration route(s) by stock, together with appropriate travel times and diversion rates. The outputs presented in this report are: run size and catch by stock, proportion of catch obtained in each fishery, and entering run timing by stock. In addition, the run reconstruction process produces week-by-week harvest rates by fishery, together with weekly and annual stock proportions in each fishery. These fishery-oriented results will be published separately in a future report, as will a full compilation of the input data.

Taken together, the inputs outlined above comprise the best available data base for many types of stock assessment analyses. While much of the data is based on informed judgements rather than on experimental results, and is certainly liable to be improved and updated over time as new information is obtained, there is considerable value in bringing it together in one location as a benchmark for future analyses.

A great many numbers are generated in a run reconstruction analysis, all of which are necessary to judge the accuracy and reasonableness of the final output. However, the most important results are the annual stock-by-stock estimates of run size, catch and escapement.

Table 15 summarizes the results, displaying for each stock the trend in run size and escapement over the time period 1970-82. Judging trends in data is a somewhat subjective exercise; where it seems appropriate, more recent years have been emphasized in making such judgements. In any case, the reader is encouraged to examine the stock-by-stock results and come to one's own conclusion.

Combined North Coast and combined Central Coast sockeye show no noticeable trends in run size, catch and escapement between 1970 and 1982, although 1981 and 1982 estimates were well above average on the North Coast. Queen Charlotte Islands sockeye show distinct downward trends in each of run, catch and escapement; these trends are driven primarily by a decline in the Area 2E stock. The West Coast of Vancouver Island, on the other hand, is experiencing an upward trend in sockeye run, catch and escapement, with the latter showing a steady increase while run and catch show greater variability. South Coast sockeye, composed predominantly of Fraser River stocks, shows no particular trend over the 1970 to 1982 period. Even looking more closely at 4-year cycles there are no strong

patterns, except for the dominate 'Adams' cycle (1970, 1974, 1978, 1982) which displays a noticeable increase over time.

Also shown in Table 15 is an estimate, for each stock, of the level of confidence we place in the results for that stock, measured as a 'high', 'medium' or 'low' level of confidence. The estimates are based largely on our perception of the reliability of the data base for each stock. A low level of confidence arises from poor escapement data, a poor understanding of escapement timing, and higher than average uncertainty about migration routes, diversion rates, and 'proportion local' for the catch in each fishery.

The quality of the results for a particular stock is affected not only by the specific inputs for that stock, but also by assumptions made about other stocks. Since catch in a given fishery is allocated between stocks on the basis of their relative sizes in the fisheries (measured by the escapements from that fishery), signigicant changes in escapement, diversion rates or timing for one stock can lead to corresponding shifts in the results for other stocks. The extent of such sensitivity to other stocks depends on the specific uncertainties involved. In general it appears that (i) large stocks are insensitive to variations in the inputs for small stocks, and (ii) roughly equal sized stocks are subject to the greatest inter-stock sensitivity in the results. However, conclusions depend very much on the distribution of each fishery's catch over the season, and in particular small stocks can be very sensitive to uncertainties in assumptions made regarding large stocks, under certain circumstances.

As a whole, the abundance of British Columbia sockeye was relatively stable between 1970 and 1982, with some increase experienced in recent years (1981, 1982) as the result of increases in Fraser and Skeena stocks. However, one should note that temporal stability in the combined run size of all B.C. stocks, in the presence of increases in enhanced production, implies a decline in unenhanced stocks.

We have attempted herein to bring together relevant data on B.C. sockeye stocks and to analyse this data, with the goal of producing information that can be used in further studies to derive a full picture of the current status of sockeye stocks and their potential for increased production. The input data, and the resulting outputs, are likely to change over time as new information becomes available. Such updating is to be encouraged. Indeed, it is hoped that this report has indicated areas where data of high quality is of critical importance, and where greater data collection efforts would be helpful to assessment and management. This is by no means the final word on British Columbia sockeye, but it may prove a useful base for comments, criticism and further analysis.

Table 15. Trends in British Columbia sockeye stocks (run size and escapement), together with estimates of confidence levels in the results for each stock.

Stock	Trend	Level of Confidence
Area 1	no trend	low-medium
Area 2W	no trend	low
Area 2E	decreasing	low
Area 3 Meziadin	no trend	high
Area 3 Non-Meziadin	decreasing	low-medium
Area 4 Early Run	no trend	medium
Pinkut/Fulton/Morrison	increasing	high
Babine Lake and River	increasing	medium
Area 5	decreasing	low-meduim
Area 6	no trend	low-medium
Area 7	no trend/dec(1)	low
Fisher-Fitzhugh	no trend	low
Dean	decreasing	medium
Bella Coola	decreasing	medium
Area 9	no trend	high
Area 10	no trend	high
Great Central Lake	increasing	high
Sproat Lake	increasing	high
Henderson Lake	increasing	low
Nimpkish	decreasing	low
Fulmore	decreasing	low
Heydon	decreasing	low
Phillips	uncertain	low
Sakinaw	no trend	low
Early Fraser	no trend(2)	high
Late Fraser	no trend(2)	high
Lake Washington	no trend	high

Notes:

(1) No trend in run size, but decrease in escapement.

(2) The 1970/82 cycle year may have a general upward trend in both the Early and Late Fraser stocks. However, there are only four points on which to base this trend in this analysis.

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Appendix 1

Analysis of Fraser River reconstruction and comparison with IPSFC data

Arranging the Fraser River data by cycle year (Early Fraser, Table A1 and Late Fraser, Table A2) shows that only the 1982/1986 cycle shows an upward trend (for both Early and Late stocks). The other stocks show a more complex picture, with runs in the mid-1970's returning at either high or low abundance levels.

The proportion of the total catch in each fishery varies considerably from year to year. In years of high diversion (i.e., a higher proportion of the stock approaching from the north), the proportion of catch taken in Johnstone Strait increases. In years of low diversion, Juan de Fuca Strait and U.S. Net predominate. In 1975, the U.S. Net catch proportion was very high because of a lengthy strike in Canada.

The total exploitation rate for the Early Fraser stock varies from 89% to 68%, averaging at 80%. Similar figures for the Late Fraser stock vary from 91% to 61%, averaging at 75%. In general, all the Early Fraser cycles and three out of the four Late Fraser cycles are exploited between 77 and 83 percent (3-cycle average, Tables A1 and A2). The major exception to this is the Late Fraser cycle when the Adams race is dominant, that cycle is harvested near 72 percent. There is also a slight trend towards decreasing exploitation rates. However, the 1981 year was exploited very heavily, against that trend. That year is the when year the Early Stuart, Late Stuart, and Quesnel races are dominant, and it is a general rule that early Fraser runs are the most highly prized, hence the high exploitation rates. This is especially true of the native food fishery, which keys in on the Early Fraser stock, even in years of high Adams River abundance (Tables A1 and A2).

Comparison of reconstruction and IPSFC estimates of total Fraser run (both Early and Late stocks combined) show substantial agreement between the two methods (Table A3). This is not very surprising since the Fraser comprises about 93% of the total south coast run (1970-1982 average). The years when the reconstruction estimate exceeds the IPSFC estimates (1975 and 1976) are years when too much catch from the Area 27 net fishery was assigned to the South Coast region (see Table 13 and Table A3). The years when the IPSFC estimate substantially exceeds the reconstruction estimate (1979 to 1982) are years when Fraser River sockeye began to be harvested in fisheries north of Cape Caution, outside the limits of this analysis (see Fig. 11). In general, the reconstructed total run estimate is never greater than 2 to 3 percent different in absolute magnitude from the IPSFC total run estimate.

The proportional split between the Early and Late stocks by the reconstruction method resembled the IPSFC splits between the same stocks (Table A4). The IPSFC uses scale identification techniques to allocate between major races. In general, the reconstruction method used such techniques as broadening the Late Fraser escapement timing curve (with a binomial distribution) or increasing the delay in the Gulf of Georgia in order to change the Early/Late stock allocation. This was done in response to excessively high harvest rates and badly skewed timing curves.

Diversion rate estimates from the reconstruction method also resemble those

made by the IPSFC (Table A4). This was done deliberately because there is no inherent reason to choose any one diversion rate over another in the reconstruction method. The reconstruction diversion rates differ slightly from the IPSFC estimates because they are estimated at escapement and varying harvest rates between the two approach routes can give slightly variable results.

Table A1. Total run, total catch, escapement, and percentage catch by fishery for the Early Fraser stock, arranged by cycle year. Averages shown are for the most recent three cycles and all percentages are calculated from the average catch and total run figures.

STOCK: EARLY FRASER

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE-MENT	EXPLI-ATION RATE	% CATCH NATIVE	% CATCH AREA 11	% CATCH AREA 12	% CATCH AREA 13	% CATCH AREA 16	% CATCH NON-CVN TROLL	% CATCH COVENT TROLL	% CATCH AREA 20	% CATCH US NET	% CATCH DIST#1
1970	1910270	1601958	308300	83.86	6.78	0.35	9.55	2.61	0.11	4.10	2.72	32.00	29.46	12.32
1974	2229160	1795911	433200	80.56	9.24	0.26	11.75	1.91	0.83	8.07	3.70	16.10	32.11	16.01
1978	2137501	1660400	477100	77.68	10.54	2.96	28.11	5.18	0.32	13.46	3.59	6.73	16.90	12.20
1982	3237423	2620787	616600	80.95	10.68	0.10	7.08	3.05	0.45	12.89	8.96	11.04	29.60	16.15
3-CYCLE AVER:	2534695	2025702	509000	79.92	10.22	0.93	14.21	3.30	0.53	11.62	5.94	11.36	26.88	15.03
1971	3986995	3563423	423600	89.38	3.87	0.01	5.67	1.57	0.58	4.89	2.01	21.03	34.74	25.63
1975	2755574	1984928	770600	72.03	11.89	0.02	3.37	0.76	0.12	5.53	0.53	8.09	49.52	20.18
1979	4043410	3875536	967900	80.02	6.90	0.14	7.36	9.41	0.04	2.64	3.76	7.19	34.68	27.88
3-CYCLE AVER:	3861993	3141302	720700	81.34	6.81	0.06	5.88	4.62	0.26	4.10	2.42	12.61	37.83	25.41
1972	3570429	2773263	797200	77.67	4.77	0.04	13.62	2.81	0.98	0.68	0.43	20.95	37.69	18.03
1976	4010894	3256222	754700	81.18	6.92	0.09	10.82	2.48	0.29	5.69	0.75	19.27	35.46	18.23
1980	2724072	1962956	761100	72.06	9.20	0.29	31.59	13.42	4.12	0.61	0.25	6.90	19.81	13.82
3-CYCLE AVER:	3435132	2664147	771000	77.56	6.73	0.12	16.89	5.28	1.47	2.71	0.51	16.82	32.39	17.08
1973	6385437	5272732	1112700	82.57	3.05	0.15	4.31	1.20	0.30	0.98	0.84	25.01	45.02	19.13
1977	5287004	4255907	1031100	80.50	5.70	0.13	6.89	2.48	2.57	0.91	0.66	15.83	36.50	28.33
1981	7335900	5958256	1377600	81.22	7.33	0.26	36.36	10.65	4.56	0.42	0.24	5.69	20.26	14.23
3-CYCLE AVER:	6336113	5162298	1173800	81.47	5.43	0.19	17.35	5.19	2.56	0.75	0.56	15.05	33.15	19.77
12-YEAR AVER:	4041983	3248362	793600	80.37	6.78	0.26	13.99	4.78	1.47	3.65	1.84	14.25	33.15	19.84

Table A2. Total run, total catch, escapement, and percentage catch by fishery for the Late Fraser stock, arranged by cycle year. Averages shown are for the most recent three cycles and all percentages are calculated from the average catch and total run figures.

STOCK: LATE FRASER

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE-MENT	EXPLOITATION RATE	% CATCH NATIVE	% CATCH AREA 11	% CATCH AREA 12	% CATCH AREA 13	% CATCH AREA 16	% CATCH NON-CVN TROLL	% CATCH COVENT TROLL	% CATCH AREA 20	% CATCH US NET	% CATCH DIST91
1970	4213640	2573778	1639900	61.08	1.65	0.53	26.02	5.03	0.14	2.64	3.89	15.01	30.84	14.24
1974	6349139	5013022	1336100	78.96	1.12	0.23	13.09	4.24	0.77	6.35	5.60	21.25	34.33	12.82
1978	7301142	5263918	2037200	72.10	1.15	1.31	36.94	15.22	0.68	6.24	1.78	9.47	19.65	7.46
1982	10555440	7147820	3407600	67.72	1.69	0.24	13.91	5.29	1.64	15.46	6.90	20.79	27.94	6.14
3-CYCLE AVER:	8068574	5808253	2260300	71.99	1.36	0.56	20.63	8.02	1.10	10.11	4.97	17.50	27.27	8.46
1971	3722257	3404030	318300	91.45	0.44	0.02	6.14	2.04	0.23	6.54	3.39	27.14	40.40	13.66
1975	969224	729428	239800	75.26	2.36	0.01	4.53	0.95	0.26	3.76	2.26	7.08	61.09	17.69
1979	1393125	953157	440000	68.42	2.39	0.27	19.70	16.73	0.08	3.74	4.78	11.82	38.43	2.06
3-CYCLE AVER:	2028235	1695538	332700	83.60	1.08	0.07	8.45	4.64	0.20	5.62	3.49	21.39	42.99	12.07
1972	164265	117523	46700	71.54	1.71	0.04	40.57	7.00	3.04	0.30	0.37	15.89	14.25	16.82
1976	435541	362963	72600	83.34	1.00	0.08	8.89	7.32	0.29	3.58	1.00	38.37	18.79	20.68
1980	316239	229038	87200	72.43	2.51	0.26	29.27	15.79	4.56	0.48	0.20	6.46	18.73	21.73
3-CYCLE AVER:	305348	236508	68800	77.46	1.61	0.13	20.72	10.00	2.13	2.04	0.64	24.35	18.02	20.38
1973	496886	428498	68400	86.24	0.47	0.08	6.89	3.11	0.02	1.85	1.92	37.58	26.90	21.18
1977	482325	399971	82400	82.93	1.01	1.17	27.79	16.12	7.29	0.52	0.78	6.88	11.54	26.90
1981	293242	228212	65000	77.82	1.89	1.19	61.31	13.11	3.44	0.94	0.87	7.30	8.14	1.81
3-CYCLE AVER:	424151	352227	71900	83.04	0.98	0.73	26.55	10.20	3.51	1.15	1.26	19.42	17.03	19.16
12-YEAR AVER:	2706577	2023132	683400	74.75	1.29	0.45	18.34	7.46	1.05	8.54	4.38	18.60	29.85	10.03

Table A3. Total run and catch figures for the combined Early and Late Fraser stocks compared with similar figures published by the IPSFC in the Annual Reports. All figures are in thousands and catch figures are for all areas outside of IPSFC convention management control.

			←——— Non-Convention Waters ———→			
	Reconstruction Total Run	IPSFC Total Run	Reconstruction Johnstone St. & Georgia St. Catch	IPSFC Johnstone St. & Georgia St. Catch	Reconstruction West Coast Catch	IPSFC West Coast Catch
1970	6124	6131	1019	1017	134	159
1971	7709	7697	566	500	397	350
1972	3735	3715	543	519	19	15
1973	6882	6914	358	339	60	50
1974	8578	8668	1185	1207	473	516
1975	3725	3664	126	112	137	95
1976	4446	4337	505	491	198	102
1977	5769	5781	723	728	41	35
1978	9439	9479	3433	3498	552	557
1979	6237	6426	1007	1010	138	335
1980	3040	3137	1084	1094	13	92
1981	7629	7712	3268	3232	27	151
1982	13793	13933	1787	1811	1443	1559

Table A4. Diversion rate estimates and proportional Late Fraser stock split estimates compared with similar estimates made by the IPSFC. IPSFC information obtained from unpublished data and is based on racial scale analysis (for stock split estimates) and on harvest rate calculations (for diversion rates estimates).

	Reconstruction Diversion Rate Estim.	IPSFC Diversion Rate Estim.	Reconstruction Estimate of Prop. Late Fraser Stock	IPSFC Estimate of Prop. Late Fraser Stock
1970	0.27	0.24	0.69	0.71
1971	0.12	0.12	0.48	0.45
1972	0.33	0.34	0.04	0.07
1973	0.08	0.09	0.07	0.07
1974	0.22	0.22	0.74	0.71
1975	0.11	0.12	0.26	0.27
1976	0.20	0.21	0.10	0.11
1977	0.18	0.18	0.08	0.08
1978	0.53	0.53	0.77	0.79
1979	0.31	0.30	0.22	0.21
1980	0.70	0.70	0.10	0.10
1981	0.68	0.67	0.04	0.03
1982	0.22	0.22	0.77	0.78

Appendix 2

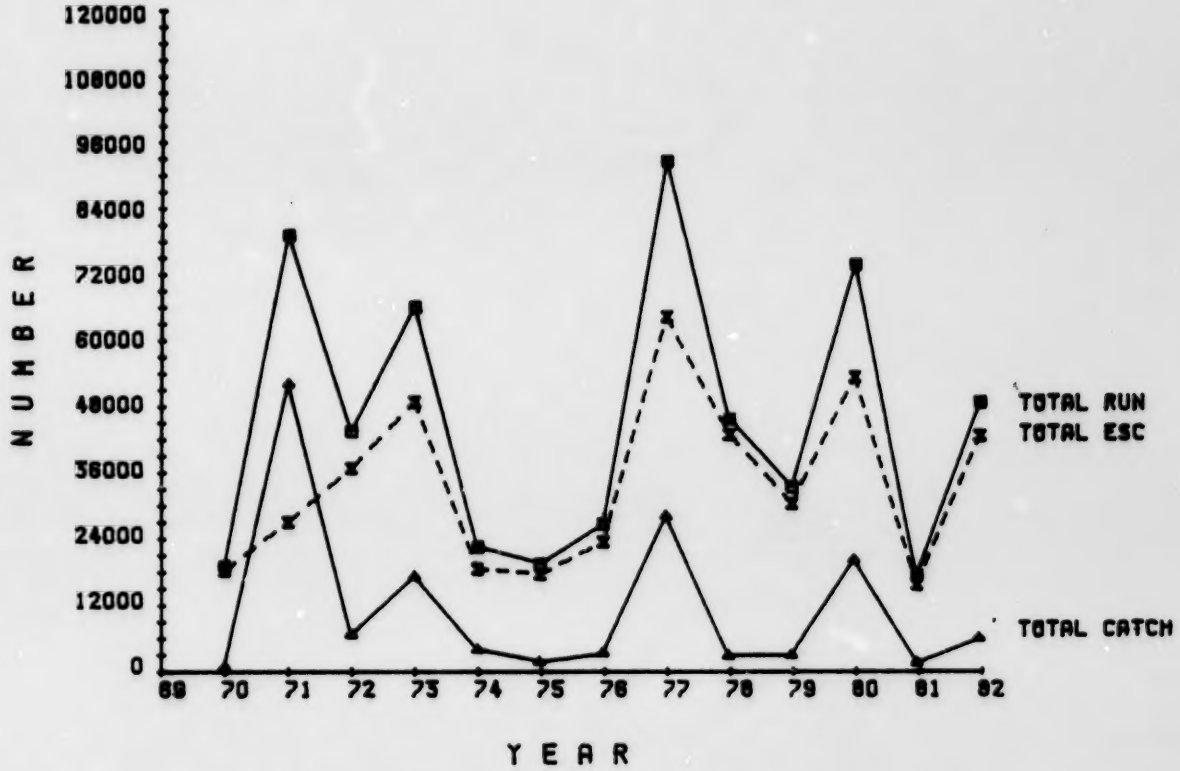
Lake Washington Sockeye

This United States stock originates from the Cedar River which flows into Lake Washington near Seattle. Its approach is southerly through Juan de Fuca Strait, where it is harvested by this major fishery (as well as to the troll fisheries off the west coast of Vancouver Island). It is also harvested by local fisheries in Puget Sound, some of which are in the IPSFC convention waters. Once in freshwater, this stock is harvested by a sport fishery in Lake Washington as well as by native commercial fisheries. Because this stock passes through the locks of a canal in Seattle, accurate run timing and escapement count information are available. However, for simplicity, the median timing point and the width of the timing curve were taken from these data and were fitted to a binomial curve. In general, the timing of this stock coincides with the earliest part of the Fraser run.

STOCK: LAKE WASHINGTON

YEAR	TOTAL RUN	TOTAL CATCH	TOTAL ESCAPE-MENT	EXPLOIT-ATION RATE	% CATCH NATIVE	% CATCH NON-CVN TROLL	% CATCH COVENT TROLL	% CATCH AREA 20	% CATCH US NET
1970	129634	5635	124000	4.35	89.14	8.39	1.83	0.63	0.00
1971	535484	352481	183000	65.82	77.83	0.25	0.08	5.07	16.76
1972	294114	45116	249000	15.34	85.31	2.20	0.10	12.40	0.00
1973	446462	116461	330000	26.09	25.67	1.62	0.53	20.04	52.14
1974	152518	26518	126000	17.39	54.52	14.60	0.77	30.11	0.00
1975	131938	11939	120000	9.05	49.81	1.71	0.69	47.79	0.00
1976	181259	22259	159000	12.28	15.94	10.10	1.44	72.53	0.00
1977	625566	190568	435000	30.46	37.33	2.58	0.75	30.47	28.88
1978	309293	19293	290000	6.24	85.43	3.06	4.01	7.49	0.00
1979	226111	20110	206000	8.89	79.89	5.95	4.69	9.47	0.00
1980	498121	137120	361000	27.53	95.18	2.07	1.23	1.51	0.00
1981	117936	10936	107000	9.27	56.18	3.25	0.66	39.91	0.00
1982	329991	40990	289000	12.42	77.25	15.51	1.31	5.94	0.00

This stock is actively managed and this is reflected in the low exploitation rates (with the exception of 1971), varying from about 5% to 30%. On the years of Early Stuart abundance in the Fraser (1973, 1977, and 1981), this stock is harvested more heavily because of early fisheries directed at the Fraser stock. The year 1981 was an exception to this because the weak run returning to Lake Washington prompted conservation actions. In general, there appears to be no major trends in total stock abundance or any evidence of a regular cyclic dominance. The majority of harvest takes place in local fisheries outside of IPSFC convention waters.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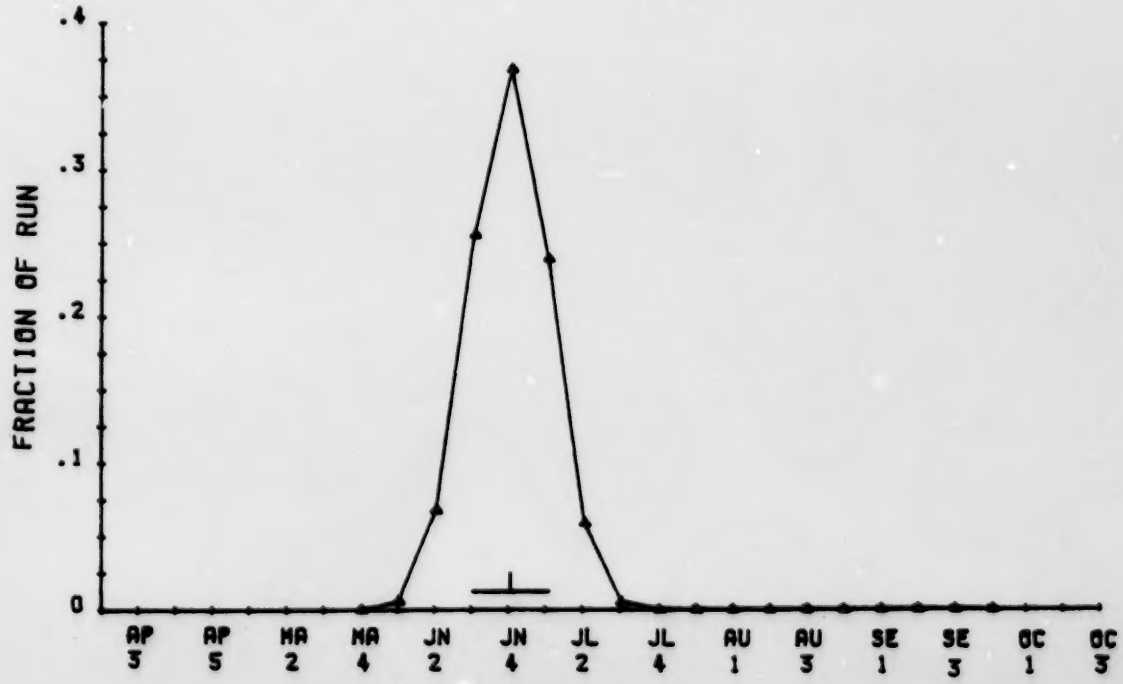
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